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ABSTRACT

A self-study was undertaken at the Massachusetts Institute of Technology (M.I.T.) to examine the impact of the federal government on it. M.I.T. is a large institution with an enrollment of 8,000, a faculty of 950, and a total teaching staff of 1,700. Of its operating expenses by far the largest source of funds in recent years has been sponsored research. Monitoring by regulatory agencies has been considerable. In the study these issues and elements are addressed: affirmative action in employment (regulations, the M.I.T.'s affirmative action plans, serious search for personnel, personnel office activities, representation of minorities, and costs of compliance); equal opportunity (regulations, and the M.I.T. response in relation to employees, students, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973); undergraduate and graduate financial aid; the institutional impact in research (research administration and direct costs); and departmental impacts in research (research volume, assessments by sponsoring agencies, the role of research, and support of graduate students). It is concluded that the institution has shown great flexibility in responding to federal funding, regulation, and priorities, and has in fact influenced federal science policies and priorities. The necessity of that kind of adaptability for institutional survival is emphasized. Sections are included focusing on safety, health, environmental protection, and animal care. Appendices include a list of persons interviewed, questionnaires, and a bibliography. (MSE)

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M.I.T. AND THE FEDERAL GOVERNMENT

An Examination of the Effects of Government Regulation and Research Support on Selected Parts of M.I.T.

An Institutional Self-Study for the Sloan Commission
on Government and Higher Education

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HE 012 442

David Garvin

1977

PREFACE

The report here presented was undertaken in the context of the work of the Sloan Commission on Government and Higher Education. Early last spring, as a preparation for it, the staff of the Sloan Foundation invited twenty-one colleges and universities to examine the impact of the federal government on them, each in its own way. They were asked to consider their relationships with the government both as regulator and as patron in the provision of student aid and research support. The institutions which accepted the invitation and produced studies were:

University of Alabama, University, Alabama
Bishop College, Dallas, Texas
Brigham Young University, Provo, Utah
University of California, Berkeley, California
Drexel University, Philadelphia, Pennsylvania
Earlham College, Richmond, Indiana
Franklin and Marshall College, Lancaster, Pennsylvania
University of Iowa, Iowa City, Iowa
Miami-Dade Community College, Miami, Florida
Ohio State University, Columbus, Ohio
Oregon State University, Corvallis, Oregon
Rice University, Houston, Texas
Roosevelt Univesity, Chicago, Illinois
Southern University A & M, Baton Rouge, Louisiana
Stanford Univesity, Stanford, California
Sterling College, Sterling, Kansas
Villanova University, Villanova, Pennsylvania
Wellesley College, Wellesley, Massachusetts
Williams College, Williamstown, Massachusetts
Campbell College, Buies Creek, North Carolina
Western Michiagn University, Kalamazoo, Michigan

At a later date, when I assumed the direction of the Commission's work, I thought it would be helpful to my understanding of these studies to be involved in one myself. Accordingly, I sought the approval of the MIT administration for a study of the same problems at MIT. The Provost, Walter Rosenblith, was receptive and helpful, as were other senior officers of the administration.

I was fortunate in finding in David Garvin, a Ph.D. candidate in the Department of Economics, the combination of intellect, energy, tact, and interest in the subject which made him well qualified to conduct the study under my supervision. Most of the interviews and other information-gathering were done in the summer and early fall of this year.

Each of the other studies in the series was an institutional product, in the sense that it was the result of an invitation accepted by the head of the institution and produced with the approval of its administration. They are thus properly termed "Self-Studies". What follows is not in that sense a self-study at all. It is a study by David Garvin with some assistance from me. As Mr. Garvin explains in his Introduction, all those who were interviewed had an opportunity to comment on an earlier draft of the study. All comments were considered carefully, and most suggestions for emendations were accepted. The Provost and other senior officers of the administration had the same opportunity to comment and to raise questions of both detail and tone, and these comments were likewise attended to. But the document which follows in no sense represents MIT's view of the problems discussed, but rather that of the author, based on the processes of interview and discussion described in the Introduction.

Carl Kaysen
Massachusetts Institute of Technology
1977

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INTRODUCTION

The Massachusetts Institute of Technology (M.I.T.), chartered in 1861, enrolled its first students on February 20, 1865. Its enrollment today is approximately 8,000, almost evenly divided between undergraduate and graduate students. Those students come from all 50 states and 92 foreign countries; in fact, the proportion of foreign students, about 18 percent, is one of the highest in an American university.

The students are instructed by a faculty of approximately 950, with a total teaching staff of 1,700. They are broadly organized into five academic schools - Architecture and Planning, Engineering, Humanities and Social Science, Management, and Science - which, in turn, consist of 23 separate departments. There are also a large number of interdisciplinary laboratories, centers, and divisions, many of which employ full-time research staffs.

The Institute's large size has resulted in a correspondingly large budget, with operating expenses of $269 million in 1976. Those expenses were met from a variety of sources, including tuition, research revenues, gifts, and endowment income. By far the largest source of funds was sponsored research, which accounted for nearly 70 percent of all revenues, followed by tuition income, which generated approximately 13 percent of the revenues. While M.I.T.'s endowment is quite large - $241 million in 1975-76 - the income it generates accounts for a relatively small share of revenues. Research, then, is the key element in M.I.T.'s finances.

M.I.T. is one of the preeminent research universities in the world. Its faculty includes many distinguished scientists and engineers, several of whom have been honored by Nobel Prizes. While other departments have broadened in recent years, science and engineering still remain the Institute's major strengths. The level of sponsored research - approximately $186 million in 1976 (campus and Lincoln Laboratories) - still exceeds that of any other American university. Of that amount, over 90 percent came from federal sources. As a result, M.I.T. is uniquely sensitive to the vagaries of federal research and development policy. Its visibility has often encouraged regulatory officials to monitor the Institute closely to insure compliance with various rules and regulations, perhaps to hold it up as an example for other colleges and universities.

This is not to imply that M.I.T. has been recalcitrant in complying with federal policies. In fact, the opposite appears to be true. When faced with new regulations, the Institute has generally reacted vigorously, framing policies that would insure compliance with the law. Task forces have been created, committees convened, and funds budgeted for those purposes. In many cases, the Institute has developed policies and implemented programs considerably broader than the minimum required by law. In part, this reflects the strong leadership provided by the administration in these and other matters at M.I.T. Members of the administration have even participated in the policy-making process more directly, helping to shape legislation that affects higher education through lobbying, consulting, and collaborating with Congress and various federal agencies.

But there is another element to the story, one of fundamental importance. In many instances, the Institute has independently initiated policies and programs in these areas years before governmental regulations were issued. Equal opportunity and affirmative action, safety and health, non-discriminatory admissions were all Institute priorities well before they became statutory commands. As a result, new regulations, with their detailed prescriptions for required behavior, have often been grafted on top of already existing policies of the Institute aimed at the same general goals. Not unsurprisingly, this has had mixed results. This theme emerges again and again in the following pages, and must be kept firmly in mind when assessing the impact of federal policies on M.I.T.

A NOTE ON METHODOLOGY

This report could not have been written without the cooperation of a large number of people. They participated in interviews, responded to questionnaires, amassed data, commented on earlier drafts of the report, and provided invaluable assistance throughout the project. Those individuals are listed in Appendix I, and receive our heartfelt thanks.

Personal interviews were the source of most information contained in the report. Two approaches were followed. Most administrators were interviewed informally, with no specific questions outlined before the interview. On the other hand, faculty and department heads were often provided with a detailed set of questions prior to the interview, in order to permit some comparison of the responses of the different departments. Only four academic sub-units were surveyed in detail - Biology, Mechanical Engineering, the Sloan School of Management, and the Research Laboratory in Electronics - chosen because they were considered representative of problems and policies throughout the Institute.

Two additional questionnaires were also employed. One, an attempt to measure the personnel and administrative costs of complying with federal regulations, was sent to all those individuals at the Institute involved in Affirmative Action efforts and in safety regulation. Those two programs were chosen to provide benchmark estimates of the costs of complying with federal programs.

The other questionnaire was sent to the Financial Aid office to provide some guidance in data collection and the identification of federal impacts. All questionnaires employed in the study are included in Appendix II.

Finally, a number of reports, print-outs and pamphlets were relied upon for background information. All are referenced in Appendix III.

In this report we have not attempted a definitive cost-benefit study of the impact of federal regulation on M.I.T. Instead, we have sought to identify those changes in institutional behavior which have been influenced by federal statutes, regulations, policies, or funding, without passing judgment upon them. Nevertheless, whenever possible, some of the costs and benefits of these measures have been estimated, if only to provide some indication of their magnitude.

AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY

In recent years the federal government has taken an increasingly active role in efforts to combat discrimination. An important precedent was established by the Civil Rights Act of 1964, which prohibits discrimination on the basis of race, color, or national origin. Subsequent legislation has broadened that mandate, banning discrimination against women, the aged, and the handicapped.

A number of principles have guided federal involvement in this area. One is the desire to provide equal opportunity for all citizens, to insure that access to employment and to education is not denied because of an individual's race, sex, religion, or physical handicaps. Another is the insistence on affirmative action to remedy the results of past discrimination, with special efforts to recruit and accommodate those groups that have previously suffered from such discrimination. These principles are embodied in different statutes and regulations, and have had quite different impacts on M.I.T.

I. Affirmative Action in Employment

A. Regulations: Affirmative Action (A.A.) requirements stem from three Executive Orders administered by the Department of Health, Education, and Welfare and the Department of Labor. Executive Order 11246 prohibits discrimination in employment on the basis of race, color, religion, or national origin, while Executive Order 11375 prohibits discrimination on the basis of sex. Both require employers to formulate and implement an affirmative action plan. According to Revised Order No. 4, which sets forth the detailed requirements for those plans, employers must conduct a utilization analysis of their work force to determine if women and minorities are underrepresented in any job categories relative to their labor pools. If deficiencies are found, goals and timetables must be established to remedy the imbalances. Should an institution be found out of compliance, the federal government has the power to withhold those funds (e.g. student aid, research support) normally granted to the institution.

B. The M.I.T. Response: While M.I.T. has had a long-standing policy of non-discrimination - first adopted formally in 1959, when the Institute's supervisor's manual first included a statement on non-discrimination, but having existed informally many years earlier - its first formal affirmative action efforts came in 1968. In September of that year, President Howard Johnson convened an Ad Hoc Task Force on Equal Employment Opportunity, charging it to recommend "ambitious but realistic goals for increasing the employment and upgrading of members of disadvantaged minority groups, especially Negroes at M.I.T." and to suggest policies for achieving those goals. The task force delivered its report on July 15, 1969; three months later an A.A. plan was adopted to carry out its recommendations. The objective of that plan was "to increase significantly the representation from minority groups, particularly blacks, among the student body and the employees of the Institute, and to extend to the disadvantaged of all races new opportunities to join the M.I.T. community." Two features of that plan deserve special comment - its inattention to problems of sex discrimination, and the absence of detailed departmental goals. The first deficiency was addressed in 1971 by a memorandum from President Johnson circulated to all academic and administrative department heads, emphasizing the need for policies aimed at furthering equal opportunity for women. The second, however, created serious problems. Because the original A.A. plan was written by a single committee addressing the problems of the Institute as a whole, individual departments were not incorporated in the planning process. As a result, Institute-wide goals were established for the hiring of minorities. Each department was expected to hire one minority faculty member to insure that those goals were achieved. Little attention was paid to the different problems facing each department. One administrator has pointed out that this had the effect of making A.A. "everybody's problem and yet nobody's problem." Some progress, however, was made, with the best performance coming in those areas where authority could be centralized. For example, gains were made in clerical and hourly categories, where the Personnel Office plays an important role.

In 1970-71 the federal government first became involved in this process. At that time HEW's Office of Civil Rights initiated a formal review of M.I.T.'s A.A. plan, concluding that the Institute was in full compliance with the law. In 1972, after the issuance of Revised Order No. 4, the plan was again reviewed, and this time was found inadequate. The Institute worked informally with HEW officials over the course of several months in order to improve the plan, although no official Institute or department plans were written. In early 1973, HEW regulations were again changed - approved A.A. plans would now be required if an institution were to receive any federal grants or contracts. M.I.T. initiated a crash program to comply with the new regulations and to insure that no federal contracts were withheld because of the absence of an A.A. plan. A new plan was issued shortly thereafter, and was approved by HEW. All subsequent plans, updates, and annual reports have been similarly approved.

C. M.I.T.'s Affirmative Action Plans: The 1973 A.A. plan has served as the model for all later plans at the Institute, with only minor modifications. All plans have included two basic elements - hiring goals, setting forth the number of women and minorities sought for various positions, and procedural requirements, detailing the practices to be followed in the implementation of the plan.

Hiring goals are now established in a decentralized fashion, with each department projecting the number of women and minorities it expects to hire in a number of employment categories, including academic, staff, and support positions. These projections are based on availability analyses which attempt to estimate the supply of qualified women and minorities in each job category, to provide a basis for realistic hiring goals. After each department has established its own goals in each category, these are then aggregated to form the Institute's goals. This decentralized approach, first adopted in 1973, was considered a major innovation in the design of A.A. plans. M.I.T. was one of the first institutions to adopt that approach. It was prompted largely by internal dissatisfaction with the Institute's original A.A. plan, which had proposed Institute-wide goals with little input from the individual departments, a method which had not proven especially successful.

The procedural requirements for A.A. differ according to the nature of the appointment. Initially, departments were required to give evidence of "serious search" - showing that consideration had been given to the full pool of qualified women and minorities in all academic appointments. That requirement was soon found to be unwieldy and overly time consuming. Documentation of serious search is now required only of appointments to faculty, sponsored research staff, library staff, medical staff, and administrative positions. In the past, such evidence was provided after the fact - at the time that an individual was being recommended for appointment - and only in those cases where a woman or minority person was not being recommended for the position. That procedure has recently been modified to permit closer scrutiny of the search process by the administration. In order to comply with the new requirements, department heads must explain in detail (and in writing) the search process they intend to follow. Those procedures are first reviewed by the appropriate dean, and then by the Academic Council. Only after they have been approved - often with modifications - is the department permitted to begin its search.

Recruitment for exempt, bi-weekly, and hourly positions (defined in the notes to Table 1) is governed by a different procedure. Hiring in those categories is supervised by the Personnel Office. Department and administrative heads first notify the office of any vacancies. The personnel officer responsible for that area then coordinates posting and advertising, refers qualified applicants to the department for interviews, and monitors the process. Department heads, however, are still responsible for the final hiring decision.

D. Assessment

1. Serious Search: Departments are quite independent in the creation and implementation of their A.A. plans. They are expected to be well-informed about the supply of qualified individuals in their fields, and able to project realistic hiring goals. While the Institute's EEO officer collects data on goals, the individual utilization analyses are not closely scrutinized. As a result, serious search requirements play the central role in improving equal employment access for women and minorities.

Many of M.I.T.'s departments - like their counterparts in other institutions - have traditionally relied on a network of informal contacts (the "old boy" network) when searching for academic and research staff. That network, spread throughout leading American and foreign universities, has in the past provided the Institute with a very large percentage of its serious job applicants. Some professors maintain that it is the only way to get the most highly qualified people, because it permits the asking of "rank order" questions in assessing candidates (i.e. Is candidate X better than

TABLE 1

Summary of Changes in Representation of Minority Group Members and Women at M.I.T. and Employment Goals for July 1977 (Campus Only)

	Actual Employment							Goals
Employment	Nov. 1970	May 1972	Sept. 1973	Sept. 1974	Sept. 1975	Sept. 1976	Sept. 1977	July 1977
1. Faculty Tot.	947	904	959	975	963	971	986	986
- Tot. Minority	53 (6%)	60 (7%)	65 (7%)	60 (6%)	80 (8%)	82 (8%)	76 (8%)	73 (7%)
- Tot. Black	8 (1%)	8 (1%)	17 (2%)	16 (2%)	20 (2%)	20 (2%)	16 (2%)	30 (3%)
- Tot. Women	17 (2%)	23 (3%)	47 (5%)	56 (6%)	62 (6%)	67 (7%)	76 (8%)	87 (9%)
2. Other Acad. Tot.*	1,091	1,105	1,164	1,255	1,250	1,368	1,511	1,563
- Tot. Minority	106 (10%)	134 (12%)	148 (13%)	147 (12%)	139 (11%)	143 (10%)	167 (11%)	123 (8%)
- Tot. Black	19 (2%)	35 (3%)	27 (2%)	26 (2%)	17 (1%)	26 (2%)	23 (2%)	33 (2%)
- Tot. Women	187 (18%)	214 (19%)	244 (21%)	264 (21%)	294 (24%)	303 (22%)	338 (22%)	350 (22%)
3. Admin. Staff Tot.	364	362	394	463	458	470	483	479
- Tot. Minority	12 (3%)	16 (4%)	23 (6%)	31 (4%)	28 (6%)	27 (6%)	30 (6%)	39 (8%)
- Tot. Black	11 (3%)	15 (4%)	17 (4%)	21 (6%)	19 (4%)	19 (4%)	18 (4%)	25 (5%)
- Tot. Women	53 (14%)	75 (21%)	113 (28%)	132 (29%)	143 (31%)	146 (31%)	173 (36%)	153 (32%)
4. Spon. Rsch. Tot.**	1,341	670	672	602	596	639	610	566
- Tot. Minority	73 (5%)	49 (7%)	48 (7%)	50 (8%)	48 (8%)	59 (9%)	53 (9%)	49 (9%)
- Tot. Black	16 (1%)	6 (1%)	10 (1%)	9 (1%)	11 (2%)	14 (2%)	10 (2%)	23 (4%)
- Tot. Women	164 (12%)	137 (20%)	127 (19%)	135 (22%)	137 (23%)	140 (22%)	136 (22%)	135 (24%)
5. Exempt, admin., & tech. Tot.	446	312	315	342	359	349	361	335
- Tot. Minority	25 (6%)	16 (5%)	23 (7%)	24 (7%)	23 (6%)	20 (6%)	21 (6%)	23 (7%)
- Tot. Black	19 (4%)	15 (5%)	19 (6%)	20 (6%)	18 (5%)	15 (4%)	18 (5%)	17 (5%)
- Tot. Women	65 (15%)	84 (27%)	101 (32%)	130 (38%)	142 (40%)	149 (43%)	159 (43%)	140 (42%)

*Variances in percentages caused by significant change in the total population in this category unforeseen at the time the goal was set. Goals were not projected to include research affiliates, post-doctoral fellows, unsalaried guests and visitors to the Institute.

**November 1970 data includes Draper Laboratory which divested from M.I.T. in July, 1970.

Table 1, continued

		Actual Employment						Goals
	Employment	Nov. 1970	May 1972	Sept. 1973	Sept. 1974	Sept. 1975	Sept. 1976	Sept. 1977	July 1977
6.	Office, Cler. Tot.	1,855	1,696	1,586	1,551	1,434	1,486	1,457	1,459
	- Tot. Minority	146 (8%)	180 (11%)	200 (13%)	204 (13%)	173 (12%)	165 (11%)	147 (10%)	256 (18%)
	- Tot. Black	89 (5%)	116 (7%)	132 (8%)	135 (9%)	121 (8%)	119 (8%)	105 (7%)	181 (12%)
	- Tot. Women	1,546 (83%)	1,417 (84%)	1,308 (82%)	1,299 (84%)	1,225 (85%)	1,270 (85%)	1,246 (86%)	1,266 (87%)
7.	Hourly Tot.	1,943	1,372	1,202	1,213	1,149	1,208	1,189	1,052
	- Tot. Minority	209 (11%)	168 (12%)	154 (13%)	177 (15%)	184 (16%)	188 (16%)	195 (16%)	204 (19%)
	- Tot. Black	173 (9%)	142 (10%)	135 (11%)	160 (13%)	155 (13%)	160 (13%)	152 (12%)	157 (15%)
	- Tot. Women	194 (10%)	179 (13%)	171 (14%)	180 (15%)	171 (15%)	193 (16%)	176 (14%)	156 (15%)
8.	Tot. Employment	7,987	6,421	6,292	6,401	6,209	6,494	6,598	6,440
	- Tot. Minority	624 (8%)	623 (10%)	661 (11%)	693 (11%)	675 (11%)	685 (11%)	689 (10%)	767 (12%)
	- Tot. Black	335 (4%)	337 (5%)	357 (6%)	479 (7%)	361 (6%)	374 (6%)	352 (5%)	466 (7%)
	- Tot. Women	2,226 (28%)	2,129 (33%)	2,111 (34%)	2,196 (34%)	2,174 (35%)	2,770 (35%)	2,304 (35%)	2,287 (36%)

Notes:

1. Faculty includes Professor, Assoc. Professor, Asst. Professor including visiting professors.
2. Other academic appointments includes instructors, lecturers, research associates, other research, teaching staff, library and medical staff.
3. Administrative Staff includes general administration of the Institute e.g., Fiscal, Personnel Student related etc.
4. Sponsored Research Staff includes professional staff members normally attached to a research project, i.e., research physicist, engineer, economist etc.
5. Exempt Staff have supervisory, technical or administrative responsibilities.
6. Office Clerical includes computer operators, secretarial, clerical staff.
7. Hourly category includes union and non-union employees.
8. Part-time staff are included in all categories.

candidate Y? How much better?), questions that might not be answered in writing. In addition, many of M.I.T.'s departments rank among the finest in the nation, and are interested in attracting only the very best people, people who have traditionally been trained by a small number of graduate schools. In that context, the "old boy" network is a relatively efficient mechanism for ferreting out candidates, for it permits the informal monitoring of high quality students throughout their graduate courses.

Serious search requirements have not modified this process appreciably, other than to increase documentation and to insure that women and minority candidates are given more attention. While some of the departments we surveyed advertise available positions, others maintain that advertising does little more than generate increased paperwork. A large number of candidates respond to the advertisements; few, if any, are at all qualified, and yet all have to be answered personally. Even the departments that do advertise admit that few serious candidates have been produced as a result. However, departments in the humanities and the social sciences, which were not reviewed for this study, do appear to generate a large number of serious candidates through advertising campaigns. The observations presented here obviously do not apply to those departments.

In some cases, A.A. requirements have led departments to cast their nets a bit more widely in the search for qualified applicants, although the departments we surveyed did not believe that the process had turned up many serious candidates who would not otherwise have been considered. Letters have been sent to predominantly black schools, or to other institutions that in the past would not have been contacted. However, this practice is by no means universal, and its use or non-use generally reflects the degree of commitment of the department to the goals of A.A.

The three departments surveyed believed that the serious search requirements have led to their focusing increased attention on women and minority candidates. Some maintain active files of such individuals, and regularly review those candidates when positions become open. In many cases there are candidates who in the past would not have been seriously considered, often because their credentials were not thought to be as impressive as those of other applicants. Almost all of those individuals, however, have been tapped through the "old boy" network, and not through new channels of information. In fact, a recent informal survey found that all black faculty at M.I.T. had been recruited as a result of their contact with someone already here, often another black faculty member, and not through advertising or other public announcements. For example, the first black full professor was recruited by the administration as a result of personal contacts that several senior administrative officials had had with him in local public affairs.

A.A. requirements have had a major impact on the duration of the search process, although this, too, appears to vary by department. Some professors claimed that their process was little changed, others estimated that it was 40 to 50 percent longer, and still others felt that searches were now two or three times more time consuming. There are two explanations for the increased duration of searches. One is the documentation required by the Academic Council to insure that serious search has in fact taken place. A largely informal, word-of-mouth process has been transformed into one that necessitates considerable paperwork, with much more careful attention to required procedures. The second explanation relates to the actual offering of jobs. In the past, once a highly qualified and highly recommended candidate was found, he or she was often hired on the spot, with little concern for the formalities of a nationwide search. If such a candidate is found today, a thorough and complete search must still be conducted, even though that candidate is almost certain to be offered the position. Several departments cite such experiences; in some cases, the department had a candidate in mind even before a formal search was begun, and yet was compelled to observe all serious search requirements in order to comply with the Institute's A.A. guidelines.

2. The Personnel Office: The Personnel Office can be characterized as a service organization with an important enforcement role. While it has no independent enforcement powers, it works to eliminate discrimination in the hiring, supervision, and promotion of employees, and can call in higher administrative officials should such discrimination be observed. Its position has been strengthened by the A.A. guidelines and the increased attention to issues of nondiscrimination that they have fostered. The Institute's greater sensitivity in these areas and its increased legal vulnerability have given the office more leverage in its dealings with individual supervisors and department heads.

In addition, a major reorganization of the Personnel Office was triggered by A.A. regulations. For many years the office was stratified horizontally, with each personnel officer responsible for a different category of employment (e.g. clerical workers, maintenance workers, etc.). As a result, there was little understanding of the overall structure of departments, and an inability to handle grievances, career planning, and counseling. A.A. provided the leverage for restructuring, with each personnel officer now assigned to a particular school or department, with responsibility for all job categories in that area. This change has greatly facilitated the handling of grievances, promotions, and similar personnel functions, as well as providing more careful monitoring of the hiring practices of each department.

E. The Representation of Women and Minorities: Tables 1, 2, and 3 summarize data on the employment of women and minorities at the Institute. The tables indicate progress in some areas, although the record is quite uneven. In general, M.I.T. has fared better in its efforts to increase the number of women than it has in its efforts to increase the number of minorities, especially blacks. (The record is better in the employment of minorities than in the employment of blacks largely because Oriental Americans are so heavily represented at M.I.T.) The record is particularly poor for faculty, other academic staff, sponsored research staff, and administrative staff, where the number of blacks has remained virtually constant over the past four or five years, and has consistently fallen short of Institute goals. There are a variety of explanations for these results.

Table 2

	Blacks		Minorities		Females		Total*
	No.	%	No.	%	No.	%	
Faculty							
1966	0	0%	NA	NA%	3	0%	892
1967	0	0	NA	NA	6	1	922
1968	0	0	NA	NA	12	1	929
1969	1	0	NA	NA	14	1	941
1970 (Nov.)	8	1	53	6	17	2	947
1971 (Sept.)	8	1	NA	NA	21	2	952
1972 (May)	8	1	60	7	23	3	904
1973 (Dec.)	15	2	62	7	45	5	946
1974 (Sept.)	16	2	NA	NA	58	6	986
1975 (Sept.)	18	2	64	6	61	6	953
1976 (Dec.)	18	2	NA	NA	70	7	959

*Faculty totals for 1966-1969, 1971, 1974, 1976 are as of October of that year.

NA = not available

M.I.T.

Table 3

Women Faculty at M.I.T.*

Year	Prof.	Assoc.	Asst.	Total	Total Faculty**
1966	0	2	1	3	892
1967	0	3	3	6	922
1968	2	3	7	12	929
1969	4	3	7	14	941
1970 (Nov.)	4	5	8	17	996
1971 (Sept.)	5	7	9	21	952
1972 (Dec.)	7	10	16	33	948
1973 (Dec.)	7	13	25	45	968
1974 (Sept.)	10	17	31	58	986
1975 (Mar.)	10	16	30	56	992
1976 (Dec.)	11	23	36	70	959

*Includes Visiting Women Faculty

**Totals as of October of that year

Black Faculty at M.I.T.

Year	Prof.	Assoc.	Asst.	Total
1974 (Sept.)	3	5	8	16
1975 (Sept.)	4	5	9	18
1976 (June)	4	5	9	18
1977 (Mar.)	4	5	9	18

The small number of black faculty members in part reflects the extremely limited supply of blacks educated to the required level (Ph.D.) in those fields that predominate at M.I.T. There are still comparatively few black doctoral students in science and engineering, and those that exist do not always specialize in those sub-fields in which a department is seeking new faculty.

Similar problems affect the hiring of sponsored research staff. Here, too, a doctorate is generally considered necessary for employment. Much of the research is state-of-the-art, highly specialized work being pursued in only a limited number of laboratories around the country. Project supervisors have often sought research staff trained in narrowly defined sub-fields, and have often relied on a very informal network for recruiting candidates. As a result, the representation of women and minorities in these positions has been quite low.

The problem of sub-field specialization is a difficult one. Departments often define their faculty openings in terms of a narrow specialty, rather than searching across all areas of the discipline for qualified candidates. Research staff openings are even more narrowly defined. This process has frequently had the effect of foreclosing opportunities to women and minorities who would otherwise be qualified for appointment. The new serious search procedures, which provide for administrative review prior to the carrying out of a search, may help in broadening the fields considered for recruitment. M.I.T.'s administrators, many of them well-respected scientists in their own right, are now in a position to recommend more open searches when they believe that the sub-fields sought are unnecessarily restrictive. This should help to open the process to a greater number of women and minorities without diluting the quality of faculty or research staff.

The small number of blacks in administrative positions reflects somewhat different forces. In many cases, salaries at the Institute are not competitive with what an applicant could get elsewhere. Those black candidates who qualify for administrative positions are also recruited by industry and other educational institutions, often at substantially higher salaries. Opportunities for advancement are also better in industry, where turnover is more rapid than in higher education. In a number of cases, M.I.T. has simply lost out to the competition.

The Institute's record in the hiring of blacks prompts several observations. Its inability to meet its hiring goals reflects a variety of forces, with the dominant considerations in one employment category often different from those in another. Nevertheless, the difficulties of realizing goals in any category have been compounded by the recent period of financial austerity. Nearly all departments have had to tighten their budgets, with fewer academic positions offered, especially at the assistant professor level. As a result, departments have become increasingly conservative in their hiring practices, less willing to take risks than they might have been otherwise. Some professors have suggested that more women and minorities are likely to be hired in periods of rapid turnover, when money is not so tight and higher education is experiencing growth, not contraction.

Despite the inability to meet its goals, M.I.T. has regularly been found to be in compliance with A.A. requirements. HEW regards these goals as targets, not as quotas, and appears to be more concerned with sincere efforts to open employment opportunities to women and minorities than with the unfailing realization of goals. At M.I.T. this has had the effect of institutionalizing a set of procedural requirements that promote the careful consideration of women and minorities for any available positions, without guaranteeing that goals will always be met.

Nevertheless, there has been progress, especially in the increased employment of women. While it is difficult to disentangle the many causes of these gains, the A.A. regulations have certainly played an important role. They strengthened the hand of the administration, already firmly committed to non-discrimination and the increased employment of minorities and women, and helped persuade departments to pay closer attention to those candidates in the hiring process. Progress would probably have come without the A.A. requirements, but at a much slower pace.

F. The Costs of Compliance: Most of the costs of complying with A.A. are staff and time costs. The Institute employs a full-time assistant EEO officer to oversee A.A. efforts. Both the Vice-President for Administration and Personnel (the Institute's designated EEO officer) and his assistant devote considerable time to preparing and monitoring A.A. plans, reports, and up-dates, as do various members of the Personnel Office. We have attempted to estimate these costs by means of a questionnaire which was circulated to various administrative officers. The results do not justify an attempt to estimate dollar cost figures. The annual staff costs for job posting, advertising, and recruiting never exceeded $30,000, and in many years was substantially less.

Departments, too, incur increased staff and time costs. Each department has its own EEO officer, responsible for its A.A. plan and serious search documentation. Professors, as members of search committees, spend increased amounts of time complying with the required procedures. Unfortunately, we have found it impossible to measure these costs with any precision.

The most significant of these costs were incurred when the Institute drew up its first major A.A. plan in 1973. At that time, few at the Institute had any experience with these matters. Members of the administration logged many hours with department and laboratory heads explaining the goals of the program, the required utilization analyses, and procedures for implementation. Those extensive consultations are no longer necessary. Departments have institutionalized A.A. practices, and now meet only rarely with the administration for guidance on these matters.

Departments are, however, required to update their A.A. plans every three years, a process that does not appear to be especially time consuming. The departmental EEO officers we surveyed estimate they spend one or two man-weeks completing each update, with some additional clerical and administrative assistance also required.

Out-of-pocket costs have also been incurred in complying with A.A. The most important of these have been for advertising and data processing. The Institute advertises extensively, often targeting its campaigns to women and minority candidates. Year-to-year variations in total advertising expenditures reflect the number of job openings, the success of other recruiting methods, and other factors unrelated to A.A. policies. Data provided by the Personnel Office shows that costs of recruitment advertising have never exceeded $30,000 annually, and have in many years been considerably less. These figures do not include the advertising purchased by individual departments, an amount that does not appear to be large. As we noted earlier, many departments do not advertise at all. Of the surveyed departments, only one advertised its faculty and research staff openings; its annual advertising expenses were only $300-400.

The large number of Institute employees has necessitated a major investment in data processing in order to document compliance with A.A. While the Personnel Office was independently moving toward a computer-based system, A.A. requirements provided the impetus for its immediate adoption. The set-up costs of that system were quite large, with recurrent costs somewhat smaller. The staff costs for data processing that can be directly attributed to A.A. requirements have never exceeded $20,000; in most years, the figures were far lower.

G. Summary: Executive Orders 11246 and 11375 and Revised Order No. 4 have had a profound impact on M.I.T. They have focused increased attention on the employment problems of women and minorities, and have led to concerted efforts to improve their representation at the Institute. At the same time, they have increased personnel and staff costs, and have led to substantial expenditures on advertising and data processing.

Most important, the regulations have had a pronounced effect on perceptions and expectations in hiring. While departments generally rely on the same informal network of contacts in faculty recruitment, they have intensified their efforts to locate qualified women and minorities. This "consciousness raising" is vitally important, because it insures that women and minority candidates will be given more careful consideration in hiring decisions.

Many of these changes in attitudes, however, have been prompted more by Institute policy than by federal regulations. M.I.T.'s administrators have displayed a firm commitment to affirmative action, and have actively sought to alter those policies which they felt were impeding progress in this area, whether or not such action was required by law. For example, both tenure rules and benefits policies were changed in order better to accommodate women faculty members. These efforts have led to a pronounced change in tone at the Institute, and to an increased sensitivity to the problems of women and minorities.

II. Equal Opportunity

A. Regulations: The Equal Opportunity (EO) laws prohibit discrimination on the basis of race, color, religion, sex, age, physical handicaps, or national origin. They are largely proscriptive, dictating what an institution cannot do, without prescribing affirmative efforts that must be undertaken. Among the laws governing non-discrimination in higher education, the following are the most important: Title VI of the Civil Rights Act of 1964, which prohibits discrimination on the basis of race, color, or national origin in any program or activity conducted by an institution receiving federal funds; Title VII of that Act, which prohibits discrimination in employment on the basis of race, color, or national origin; Title IX of the Education Amendment of 1972, which prohibits discrimination against students on the basis of sex; the Equal Pay Act of 1963, which prohibits discrimination in salaries on the basis of sex; the Equal Employment Opportunity Act of 1972, which prohibits discrimination in employment on the basis of race, color, religion, sex, or national origin; the Age Discrimination Act, which prohibits age discrimination in employment; and the Rehabilitation Act of 1973, which prohibits discrimination against handicapped individuals in employment and education. Not only do the provisions of these laws overlap considerably, there is also some overlap in enforcement responsibilities. Several agencies have administrative authority in this area, including the Department of Labor, the Department of Health, Education, and Welfare, and the Equal Opportunity Commission. This overlap has occasionally led to conflicting demands from different agencies, with varying requests for documentation and varying standards of compliance.

B. The M.I.T. Response: Although M.I.T. has been firmly and publicly committed to a policy of non-discrimination since 1964, the EO statutes have contributed to further changes at the Institute. These can conveniently be divided into those policies that primarily affect employees and those that primarily affect students.

1. Employees: The EO laws make it illegal to deny an individual employment or promotion on discriminatory grounds. Should such actions occur, the institution is considered to be legally liable, and may be sued by the individual in question. A well-established procedure has been developed for bringing complaints in these circumstances, with most authority vested in the Department of Labor, the local office of the Equal Employment Opportunity Commission, or the Massachusetts Commission Against Discrimination.

The Institute has adopted a number of policies to combat discrimination. The Personnel Office has been strengthened, with much closer oversight of the hiring process, and more careful attention to the reasons given by academic and administrative heads for rejecting candidates. Departments are regularly advised of the types of questions which are no longer permissible in interviews, and which might be considered grounds for charges of discrimination. The restructuring of the Personnel Office has facilitated efforts to insure that women and minorities are not denied opportunities for promotion.

The most important response, however, has been the adoption of a formal non-union grievance procedure. That procedure, while required by the A.A. regulations, has played a much more significant role in implementation of the EO statutes. Any non-union Institute employee (union employees are covered by collective bargaining agreements with their own grievance and arbitration procedures) who feels that he has been treated unjustly is encouraged to discuss the question with his supervisor; if the problem is not resolved, discussion may continue with higher supervisors, personnel officers, and the Director of Personnel Services. Should the matter still be unresolved, employees are encouraged to take the problem to one of the Special Assistants to the President and Chancellor. Those positions, one for Minority Affairs and the other for Women and Work, were established four and five years ago. In addition to serving as the final point of appeal in the Institute's grievance procedure, they play a major advisory role, informally counseling anyone at M.I.T. who wishes to come by, and reporting directly to the President and the Chancellor on issues of importance that arise from these discussions.

The EO laws also require non-discrimination in salaries. In order to comply with these requirements, the Institute now conducts annual salary equity reviews. These are regular efforts to insure that employees are appropriately classified, and that their pay scales match their qualifications, job responsibilities, and experience. The studies have shown that women faculty members, on average, earn slightly less than their colleagues, and minority faculty members slightly more, although the differences can be explained by departmental representation (e.g. there are more women in the lower paying departments) and individual characteristics (e.g. teaching experience, publications, etc.). Whenever salaries have been found to be out of line with an employee's job or qualifications, they have been adjusted accordingly. (To be more precise, adjustments are made only when salaries are found to be below equitable levels. Those who are regarded as "overpaid" according to objective criteria do not have their salaries lowered. Instead, salary increases for them become less frequent, until equity is achieved.)

Taken together, these practices have been quite successful in furthering EO at the Institute. Since the adoption of the grievance procedure, most complaints have been addressed internally, and none have had to be fought in court. While approximately 10 discrimination suits are brought against the university each year, they usually concern individuals who have applied for a job at the Institute and have not been accepted. Even those cases seldom reach litigation. As a result, M.I.T. incurs few legal expenses in defending itself on any personnel issue, although substantial staff time is invested in investigating complaints.

2. Students: The EO laws prohibit discrimination in admissions on the basis of race or sex. Unlike employment, however, where the law requires affirmative efforts for compliance, admissions is governed by no such guidelines. While institutions are told that they may not discriminate, affirmative efforts are at their own discretion. No agency has ever dictated recruitment requirements to M.I.T. This distinction is important, because the mechanisms that have evolved for insuring non-discrimination in admissions, and the problems that remain, are quite different from those that have arisen in employment.

Undergraduate admissions are governed by a single Institute committee which sets policy in the area, and by a single, centrally controlled office responsible for implementing those policies. Beginning in 1964, that committee began considering ways to increase the number of minority students at M.I.T., and adopted several new policies, including more intensive visiting of predominantly black high schools, the establishment of a special scholarship program for black students, and the creation of a summer program for black students to ease their adjustment to the Institute. In 1968 a formal policy statement was issued, emphasizing the need for strong affirmative policies to attract minority students:

> The intention of these special recruitment and admissions efforts is to seek out, identify, and encourage to come to the Institute those students of high ability and promise whose past academic achievement may have been artificially limited or masked by poverty, by social discrimination, or by severely limited horizons, and who, with appropriate support, would be able to thrive at the Institute...

That policy reflects the administration's strong commitment to the concept of EO, and its feeling that affirmative policies are required to increase the representation of minorities at M.I.T. In that respect, M.I.T. has gone well beyond the demands of the federal government.

Similar policies have governed the admission of women. During the 1960s, the number of women undergraduates was limited by the dormitory space available for them, because at the time they were required to live in their own dorms. The construction of McCormack Hall, a new women's dormitory, led to a sharp increase in the number of women. With the acceptance of co-educational housing in the 1970s, M.I.T. went to sex-blind admissions, coupled with extensive recruiting efforts to increase the number of women.

Table 4

M.I.T. Entering Class - 1967-1977

	Total	Women		Blacks		Mex. Amer.		Amer. Ind.	
		No.	%	No.	%	No.	%	No.	%
1967	914	52	5.7	8	0.9	0	0.0	0	0.0
1968	961	61	6.3	7	0.7	0	0.0	1	0.1
1969	957	69	7.2	53	5.5	1	0.1	0	0.0
1970	942	86	9.1	58	6.2	3	0.3	0	0.0
1971	984	128	13.0	46	4.7	1	0.1	0	0.0
1972	1040	117	11.3	42	4.0	6	0.6	0	0.0
1973	893	122	11.7	29	3.2	4	0.4	0	0.0
1974	1036	211	20.4	47	4.5	9	0.9	0	0.0
1975	1154	174	15.1	32	2.8	10	0.9	1	0.09
1976	1044	167	16.0	58	5.6	17	1.6	0	0.0
1977	1106	178	16.1	59	5.3	14	1.3	8	0.7

Table 4 shows changes in the composition of M.I.T.'s entering class over the past decade. The number of women has increased significantly over that period, with women now accounting for 16 percent of the entering class. The representation of Mexican Americans has also increased, although the numbers remain very small. The record for blacks, however, is less encouraging. After a sharp increase in the late 1960s, the number of blacks in each entering class has shown little change. While a variety of explanations has been offered for this phenomenon, and a number of alternative recruitment strategies have been employed, little progress has been made of late.

The increased number of women and minority undergraduates reflects the Institute's commitment to this area, rather than the influence of federal laws or guidelines. The policies of the Admissions Office have not changed significantly as a result of the EO statutes. The office has, however, moved to cover itself legally, and now includes in all of its brochures two paragraphs formally stating that the Institute does not discriminate on the basis of race, color, sex, religion, national or ethnic origin. In addition, the EO statutes have led to an important shift in the practice of the office. Increased attention is now paid to the specifics of federal regulations and to compliance with the exact letter of the law, in order to insure that the Institute is not left open to suit. This has led to increased consultation with M.I.T.'s legal counsel, increased paperwork, and the injection of an air of litigiousness into the operations of the Admissions Office. In summary, M.I.T.'s admissions officers feel that they have independently pursued affirmative policies in recruiting women and minorities, and that the EO statutes have had little effect on their efforts other than to increase their legal vulnerability.

Graduate admissions present a very different picture. Graduate admissions are decentralized, with each department having full responsibility for recruitment and admissions. Policies range from active and intensive recruitment of women and minorities to total disinterest in any special efforts, depending upon the degree of commitment of the individual department.

It is here that the weaknesses of the EO laws are most evident. Few departments (if any) appear to have discriminated against women and minorities in recent years; applicants have generally been judged on their merits, and those qualified women and minorities have been accepted. While such behavior complies fully with the EO statutes, it has not always generated a large number of women and minority applicants. And it is the number of applicants that has served as the major bottleneck to increasing the representation of these groups among graduate students, as shown by Tables 5 and 6.

Many of M.I.T.'s departments, consistently ranked among the finest in the country, have never formally recruited graduate students, believing that such efforts were unnecessary given their high quality and national reputations. The expectation was that qualified students would apply without solicitation. While that may be true of white males, it is often not true of women and minority students. Some may be intimidated by M.I.T.'s reputation, or by the

Table 5

Women Graduate Students at M.I.T.

	Applications from Women		Enrollment of Women	
	No.	%	No.	%
1971	581	9.4	260	8.0
1972	649	11.2	304	9.0
1973	812	13.7	318	9.5
1974	954	14.9	405	11.6
1975	1105	16.5	487	13.5
1976	1170	16.5	546	14.5

Percent Increase in Women Applicants, 1971-1976: 101.4

Percent Increase in Women Graduate Students Enrolled, 1971-1976: 110.0

Women Graduate Students in Selected Departments

	Mechanical Eng.		Biology		Sloan School	
	No.	%	No.	%	No.	%
1971	4	1.9	37	36.0	14	2.5
1972	2	1.0	52	45.0	11	3.0
1973	4	1.4	46	36.0	27	8.0
1974	2	1.0	45	35.0	49	14.0
1975	10	5.0	41	34.0	74	22.0
1976	11	5.0	40	30.5	79	19.9

Table 6

Minority Graduate Students Enrolled at M.I.T.

	Blacks		All Minorities	
	No.	%	No.	%
1970	55	1.6	NA	NA
1971	88	2.7	NA	NA
1972	87	2.6	108	3.2
1973	97	2.8	121	3.6
1974	123	3.5	151	4.3
1975	119	3.3	155	4.3
1976	130	3.4	178	4.7

thought of pursuing a Ph.D. in science or engineering. As a result, many do not even apply to M.I.T.

The EO laws have had little impact in this area, since they do not require affirmative programs of recruitment, but merely prohibit discrimination. Even so, Tables 5 and 6 show that the number of women and minority graduate students at M.I.T. has increased in recent years. Women especially have registered strong gains. The record, however, is quite uneven, and varies sharply across departments. In fact, most of the gains have been concentrated in a relatively small number of departments, departments that have displayed firm commitments to EO and have independently pursued programs of recruitment.

The administration, through the Office of the Graduate Dean, has begun working with individual departments in an effort to increase the number of women and minority graduate students through intensified recruiting. Unlike A.A. in employment, however, there is no statutory authority that can be invoked here to promote compliance. As a result, the administration must rely upon voluntary cooperation from the departments. Traditional practices have been slow to change in this area, and many departments remain reluctant to recruit.

3. Title IX of the Education Amendments of 1972: Title IX is unusual among the EO statutes in that it not only prohibits discrimination (against students on the basis of sex), but also requires institutions to conduct self-evaluations and to remedy deficiencies if they are found. In response to that requirement, M.I.T. formed

a special Title IX committee to review all Institute policies, to identify sources of discrimination, and to propose recommendations.

While a number of changes have resulted from that review, the most important have concerned the Athletic Department. While the Medical Department has in recent years become more sensitive to the needs of women, administrators differed on the extent to which they felt these changes resulted from Title IX. The Athletic Department, however, has expanded the programs and facilities available to women. While it is again difficult to disentangle the impact of Title IX from those efforts that were being independently pursued by the Institute prior to it, the regulations did lead to some immediate improvements, although the major impetus to change was provided by faculty and administration committees working independently of the law. A number of women's coaches were hired; locker, dressing, and shower facilities for women were expanded; and team schedules were upgraded. In total, these improvements cost the university $78,600 over the past two or three years - $27,500 for salaries, $42,000 for facilities, and $9,100 for operating programs.

4. The Rehabilitation Act of 1973: This Act requires institutions to prepare A.A. plans to insure that EO goals are met. Section 503, administered by the Department of Labor, mandates affirmative efforts to employ those individuals who, though mentally or physically handicapped, are otherwise qualified for a position. Employers must make "reasonable accommodation" for handicapped individuals, with standards of reasonableness defined as those actions not imposing undue hardship on the institution. While A.A. plans are required

for compliance, and must include a review of current policies to see if the institution is discriminating against the handicapped, as well as a positive outreach program, detailed hiring goals and timetables need not be specified.

The Institute is moving ahead slowly in this area. While a small amount of money has been allocated to the Department of Personnel for making "reasonable accommodations," little has been spent to date. The Planning Office is working up detailed estimates of the costs of modifying M.I.T. facilities to provide for the handicapped, but these are highly uncertain. The problem lies in the vagueness of the law, and the absence of any clear interpretation of "reasonable accommodation." For example, the Institute has long had tactile maps for the blind, wheelchair ramps, and special bathrooms to accommodate the handicapped. Are these sufficient to insure compliance with the law, or is more required? In the absence of clear direction from Washington, the Institute has opted for a "wait and see" policy, moving ahead slowly with its program without committing funds to a massive construction effort.

Section 504 of the Act involves similar problems. It prohibits discrimination against handicapped individuals in education and employment (with the employment provisions nearly identical to those of Section 503). However, this section is administered by the Department of Health, Education, and Welfare, which creates the potential for conflicting demands by the agencies monitoring Section 503 and Section 504. Section 504 also requires a self-evaluation to insure that handicapped students are not discriminated against in admissions, financial aid, counseling, housing, or other areas of concern, and an A.A. plan to insure that the campus is free of barriers that might impede handicapped students. As with Section 503, the extent to which existing facilities must be modified remains unclear.

M.I.T. now enrolls approximately 10-15 handicapped students (there may be others who have not come forward to identify themselves). In the past, the Institute has given them individualized attention, providing counseling and other special assistance. It is not yet clear whether this policy must be modified to comply with the requirements of Section 504.

5. Summary: The impact of the federal EO statutes must be assessed in the context of the Institute's clear commitment to nondiscrimination. Those laws grafted a set of legal responsibilities on top of voluntary policies being pursued independently by M.I.T.

One result has been an increased sensitivity to compliance with the letter of the law, to insure that the Institute is not legally vulnerable. Compliance efforts have occasionally been slowed by the ambiguity of the laws, and by the absence of clear guidelines on precisely what behavior is required. Those difficulties have been compounded by a lack of feedback from the administering agencies, the perceived lack of understanding of the university among agency compliance officers (a common complaint of M.I.T. administrators and personnel officers), and considerable overlap in agency responsibilities (which occasionally results in conflicting demands for compliance).

Most of the EO statutes prohibit discrimination without prescribing affirmative efforts to be undertaken as a remedy. This has led to widely varying responses at the Institute. In those areas under the control of the central administration (e.g. undergraduate admissions), where the commitment to EO appears to be most firmly rooted, strong affirmative efforts have been pursued even though they are not required by law. In other areas, where control is decentralized (e.g. graduate admissions) the results are more uneven, and reflect the degree of commitment of the individual departments.

More generally, we find the independent impact of the EO statutes, like those applying to A.A., difficult to assess. A wide variety of forces, including pre-established Institute policy, strong administrative leadership, faculty commitment, and student initiative have all contributed to M.I.T.'s progress in these areas. While the statutory commands of the federal government undoubtedly played a significant role, their precise impact cannot be untangled from that of these other agents.

FINANCIAL AID

As the costs of attending college steadily increase, the provision of student financial aid becomes ever more important. Without it, a college or graduate degree would be unattainable for many individuals. The federal government has traditionally played a major role in these efforts, providing substantial support for both undergraduate and graduate students. As a result, M.I.T. has come to depend heavily on federal funds for financial aid.

I. Undergraduate Aid: Table 1 presents the basic data on undergraduate enrollment and financial aid. The percentage of all students supported has fallen from the late 1960s, and now stands at 45 percent (down from a high of 61 percent in 1968-69). That decline is largely the result of the Financial Aid office having introduced a new requirement in the early 1970s -- that a copy of the parents' income tax forms must accompany a student's application for financial aid. As a result, many fewer students have applied for aid in recent years. Average awards, however, have risen steadily, although they have not kept pace with the increase in the estimated costs of attending college. In 1966-67, the average award covered approximately 47 percent of the student's estimated budget (tuition, room, board, etc.); ten years later, that percentage was unchanged. Nor has the percentage fluctuated appreciably over the years.

Federal funds account for significant amounts of aid, and

Table 1

History of Enrollment and Financial Aid, 1965 to 1976

Year	#U-G	# Aided	% Aided	$ Tot. Grant	$ Tot. Loan	Tot. S/L	Av. Award	Ratio of Av. Award to Budget	
1965-66	3755	1969	52	1,731,000	1,389,000	3,120,000	1584	.46	1965-66
1966-67	3857	2159	56	2,362,000	1,606,000	3,968,000	1837	.47	1966-67
1967-68	3857	2170	56	2,800,000	1,391,000	4,191,000	1931	.50	1967-68
1968-69	3955	2337	61	2,744,000	2,010,000	4,754,000	2034	.51	1968-69
1969-70	4074	2248	56	2,733,000	2,095,000	4,828,000	2147	.52	1969-70
1970-71	4120	2270	57	2,995,000	1,510,000	4,505,000	1984	.44	1970-71
1971-72	4137	2007	52	2,796,000	1,704,000	4,500,000	2242	.45	1971-72
1972-73	4183	1973	48	2,962,000	1,876,000	4,838,000	2698	.51	1972-73
1973-74	4113	1671	42	3,014,000	1,884,000	4,899,000	2931	.48	1973-74
1974-75	4136	1791	44	3,583,000	2,192,000	5,775,000	3229	.48	1974-75
1975-76	4433	2011	45	4,229,000	2,753,000	6,982,000	3472	.47	1975-76

Note: All figures are rounded to the nearest 1,000.

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may take any of several forms. Campus-based programs include all programs in which the funds are made available to individual colleges and universities to be dispersed according to some criteria of "demonstrated need." The National Direct Student Loan (NSDL) Program, the Supplemental Educational Opportunity Grants (SEOG), and the College Work-Study Program (CWSP) all fall in this category. In contrast to these programs, Basic Educational Opportunity Grants (BEOG) are awarded directly to students, who can then apply them to the college or university of their choice. In addition, the federal government plays a major role in loan programs (i.e. the Federally Insured Loan Program and the Guaranteed Loan Program), insuring loans and paying interest on some of them.

Table 2 presents data on the dollar volume of the various federal aid programs at M.I.T., while Table 3 compares those figures with total financial aid awarded by the Institute. The tables show that the campus-based programs have become more important in recent years, and now account for fully 38 percent of all aid awarded to undergraduates. This should be contrasted with the 1966-1970 period, when federal aid percentages fell sharply.

The increase in federal aid has been accompanied by increased oversight by the Office of Education, with less freedom for M.I.T.'s financial aid officers. Reporting requirements have also increased substantially, with a commensurate rise in personnel and data processing costs. The Financial Aid Office estimates that it has incurred costs of $50-100,000 in writing and running computer programs to monitor and report on the use of federal funds. At least

Table 2

Federal Financial Aid Programs at M.I.T., 1964-65 to 1975-76

	Campus-based Programs			BEOG	Total
	NDSL	SEOG	CWSP		
1964-65	$724,000	No program	No program	No program	$724,000
1965-66	916,000	"	"	"	916,000
1966-67	772,000	$ 86,000	"	"	858,000
1967-68	807,000	118,000	"	"	925,000
1968-69	813,000	128,000	"	"	941,000
1969-70	976,000	159,000	"	"	1,135,000
1970-71	1,029,000	140,000	$260,000	"	1,429,000
1971-72	1,640,000	135,000	385,000	"	2,156,000
1972-73	1,426,000	158,000	359,000	"	1,921,000
1973-74	1,305,000	392,000	920,000	$14,000	2,507,000
1974-75	1,667,000	257,000	774,000	77,000	2,477,000
1975-76	1,896,000	450,000	1,309,000	283,000	3,472,000

Note: All figures are rounded to the nearest 1,000.

Table 3

Federal Financial Aid as a Percentage of Total Aid, 1964-65 to 1975-76

	Total Aid	Campus-based Federal Aid (NDSL + SEOG)		Total Aid Including Employment	Campus-based Federal Aid Including CWSP	
		$	As a % of Total		$	As a % of Total
1964-65	$2,616,000	$724,000	27.7	NA	NM	NM
1965-66	3,120,000	916,000	29.3	NA	NM	NM
1966-67	3,968,000	858,000	21.6	NA	NM	NM
1967-68	4,191,000	925,000	22.1	NA	NM	NM
1968-69	4,754,000	941,000	19.8	NA	NM	NM
1969-70	4,828,000	1,135,000	23.5	NA	NM	NM
1970-71	4,505,000	1,169,000	25.9	$5,424,000	$1,429,000	26.4
1971-72	4,500,000	1,775,000	39.4	5,494,000	2,156,000	39.4
1972-73	4,838,000	1,564,000	32.3	5,720,000	1,921,000	33.7
1973-74	4,899,000	1,790,000	36.5	5,826,000	2,493,000	42.8
1974-75	5,775,000	1,926,000	33.3	6,350,000	2,400,000	37.8
1975-76	6,982,000	2,346,000	33.6	8,404,000	3,189,000	38.0

Note: All figures are rounded to the nearest 1,000.

NA: Not Available
NM: Not Meaningful (CWSP funds were not awarded until 1970-71)

$15,000 of programming time went for a specific analysis that was required at one time, but has since been phased out as unnecessary. While some of these print-outs provide useful information for M.I.T.'s financial aid officers, many are of little relevance, and are produced only because they are required by the Office of Education. Personnel costs have also increased as a result of increased federal regulation and oversight. The Financial Aid Office estimates that one staff member spends one-half time processing guaranteed loans, another spends one-quarter time on federal accounting and reporting, and a third spends one-quarter time on professional association (lobbying) activity. These figures, in the aggregate, imply that federal regulation has led to the need for one additional professional.

Federal funds, as we noted earlier, are awarded only on the basis of "demonstrated need," with need established by the amount of money that a family can afford to pay for higher education. Those calculations have historically been based on the standardized tables of the College Scholarship Service (CSS), modified by the judgment of individual financial aid officers. However, there has been considerable variation in the techniques employed by different colleges and universities, and in the reliance placed on independent judgment. To introduce a greater degree of uniformity, the federal government stepped in and in 1975 required that all financial aid offices receiving federal funds employ the same system, the Uniform Methodology. That system, an outgrowth of the CSS tables, has introduced a certain inflexibility into the awarding of financial aid, and has considerably narrowed the scope of independent judgment.

While the motivation underlying the introduction of the Uniform Methodology was laudable - an attempt to cut down on the irresponsible behavior of certain institutions in the use of federal financial aid dollars - it has had serious repercussions for M.I.T. In order to insure compliance with the new system, the government has imposed more detailed monitoring requirements. These have accounted for a significant proportion of the data processing costs cited earlier, as well as occupying a great deal of staff time. The Financial Aid Office estimates that perhaps as much as one-third of its time is now devoted to complying with the demands of those regulations accompanying federal programs.

Even more serious, the Uniform Methodology has forced M.I.T.'s financial aid officers to adopt criteria for estimating need that they find unacceptable. More specifically, they feel that the federal criteria understate aggregate need, especially for middle and upper middle income families (especially those with several college-aged children) just above the need thresholds. Because those criteria must be observed even when M.I.T. money is being used (i.e., as long as some portion of the aid package is based on federal dollars, the federal standards must be met), and because the exercise of independent judgment is more difficult than in the past (and must now meet with federal approval and review), M.I.T.'s aid officers feel that they are less able to address the problems of middle and upper middle income families than they were before the Uniform Methodology.

The shortcomings of that methodology are compounded by the instability that characterizes the allocation of federal financial aid. Year-to-year variations in awards are quite common. For example, the Tri-part application (for the NDSL, SEOG, and CWSP) changes almost annually, (in review guidelines, if not in fact) as Washington reacts to political changes in party, personnel, and public opinion. Planning has become more difficult because the level of federal support is never certain. Last year, for example, M.I.T., appealed the initial decision on its allocation twice, with only limited success.

These difficulties have spawned a large lobbying effort. M.I.T. is now active in a number of organizations involved in federal aid lobbying, including the American Council on Education (ACE), the Consortium on the Financing of Higher Education (COFHE), and the Association of American Universities (AAU). In addition, M.I.T.'s financial aid officers participate in two professional associations, the National Association of College and University Business Officers (NACUBO), and the National Association of Student Financial Aid Officers (NASFAO), which also play active roles in Washington. Finally, they maintain close contact with top officials in the Office of Education, members of Congress and their assistants and committee staffs. As the number of regulations increases, the Financial Aid Office finds itself devoting increasing amounts of time to these efforts, in an attempt to prevent the adoption of those regulations it considers to be most onerous.

II. Graduate Student Aid: Table 4 presents the basic data on graduate student financial aid, and shows several important trends. The percentage of students supported by federal fellowships and traineeships has declined steadily in recent years. The percentage of all graduate students supported, however, has declined much more gradually, and actually experienced an upturn in 1975-76. The cutback in federal support was made up from several sources. Institutional support increased, with the number of students supported on M.I.T. endowed and budgeted funds quadrupling within a brief period. External sources of support, including scholarships from a number of government, foundation, and industry donors, were also expanded.

A closer examination of the early 1970s, when federal fellowship, traineeship, and research support declined dramatically, is especially enlightening. Table 5 illustrates the patterns of federal fellowship and traineeship support here at M.I.T. during that period. Unfortunately, we were unable to secure dollar figures, so the tables indicate number of fellowships and traineeships. NDEA, NSF, and NIH Traineeships were all cut back sharply, as was overall federal support of research and development. As a result, departments were unable to compensate for the lost traineeships by an increase in the number of research assistantships offered. Instead, they were forced to rely on Institute

Table 4

Graduate Financial Assistance, 1967-68 to 1975-76

	Federal Fellowships and Traineeships		Graduate Student Staff (RA + TA)		Industrial and Foundation Awards		MIT Endowed and Budgeted Funds		Students Sponsored by External Sources		Total Awards		Total Graduate Students
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	As a % of all Grad. Students	
1967-68	796	23	1,586	48	206	6	53	2	406	12	3,045	91	3,344
1968-69	797	24	1,555	48	114	3	69	2	427	13	2,962	90	3,274
1969-70	763	22	1,627	48	81	2	89	3	441	13	3,001	88	3,395
1970-71	735	22	1,501	46	108	3	132	4	421	13	2,897	88	3,296
1971-72	621	19	1,445	44	152	5	220	7	322	10	2,760	85	3,250
1972-73	493	15	1,518	46	171	5	199	6	429	13	2,810	85	3,328
1973-74	391	12	1,575	47	156	5	197	6	477	14	2,796	84	3,358
1974-75	373	11	1,609	46	166	5	242	7	513	15	2,903	84	3,468
1975-76	387	11	1,804	50	112	3	208	6	625	17	3,136	87	3,603

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Table 5

Major Federal and Institutional Support of Graduate Students at M.I.T.

Fall Term

Fellowships and Traineeships Awarded by M.I.T.	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78 (Est.)	
*Energy Research and Development Administration Traineeships (Formerly AEC Traineeships)	--	--	--	8	13	13	6	14	8		
*Environmental Protection Agency Traineeships	--	--	--	6	6	6	6	6	6		
*HEW Domestic Mining and Mineral Fuel Traineeships	--	--	--	--	--	--	--	2	8		
*National Aeronautics and Space Administration Traineeships	24	9	--	--	--	--	--	--	--	--	Program discontinued
*National Defense Education Act Traineeships	137	128	80	80	50	25	3	3	--	--	Program discontinued
*National Institutes of Health and Other HEW Traineeships	116	146	160	167	172	140	167	165	130		
*National Science Foundation Traineeships	151	143	141	96	49	23	--	--	--	--	Program discontinued
*National Science Foundation Energy (National Needs) Traineeships	--	--	--	--	--	--	12	22	27	19	Program to be discontinued in 1980
Sloan Research Traineeships	--	--	--	90	77	40	32	--	--	--	Program discontinued

Table 5 (cont.)

Fellowships Awarded by Sponsors to M.I.T. Students	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78 (Est.)	
*Atomic Energy Commission Fellowships	36	32	25	14	5	--	--	--	--	--	Program discontinued
*Environmental Protection Agency Fellowships	--	--	--	1	1	2	2	--	--	--	
*Housing and Urban Development Fellowships	7	11	7	2	2	1	--	--	--	--	Program discontinued
*National Aeronautics and Space Administration International Fellowships	6	3	3	14	2	--	--	--	--	--	Program discontinued
*National Institutes of Health and Other HEW Fellowships	74	67	41	19	9	2	2	3	4		
*National Science Foundation Fellowships	245	218	267	215	193	184	176	145	142	138	
TOTAL	796	757	724	712	579	436	406	360	325		
*Federal Programs Only	796	757	724	622	502	396	374	360	325		
Research Assistants	1,061	1,118	996	964	1,036	1,073	1,142	1,366	1,264		
Teaching Assistants	494	509	505	481	482	502	467	438	486		

resources in the form of increased scholarships, traineeships, and teaching assistantships. For example, the Sloan Research Traineeships, offered by the Institute in 1971-72 through 1974-75, took up much of the slack, as illustrated by Table 5. Those awards were created specifically to compensate for the federal cutbacks. Similarly, Table 6 shows the increased importance of teaching assistantships during this period.

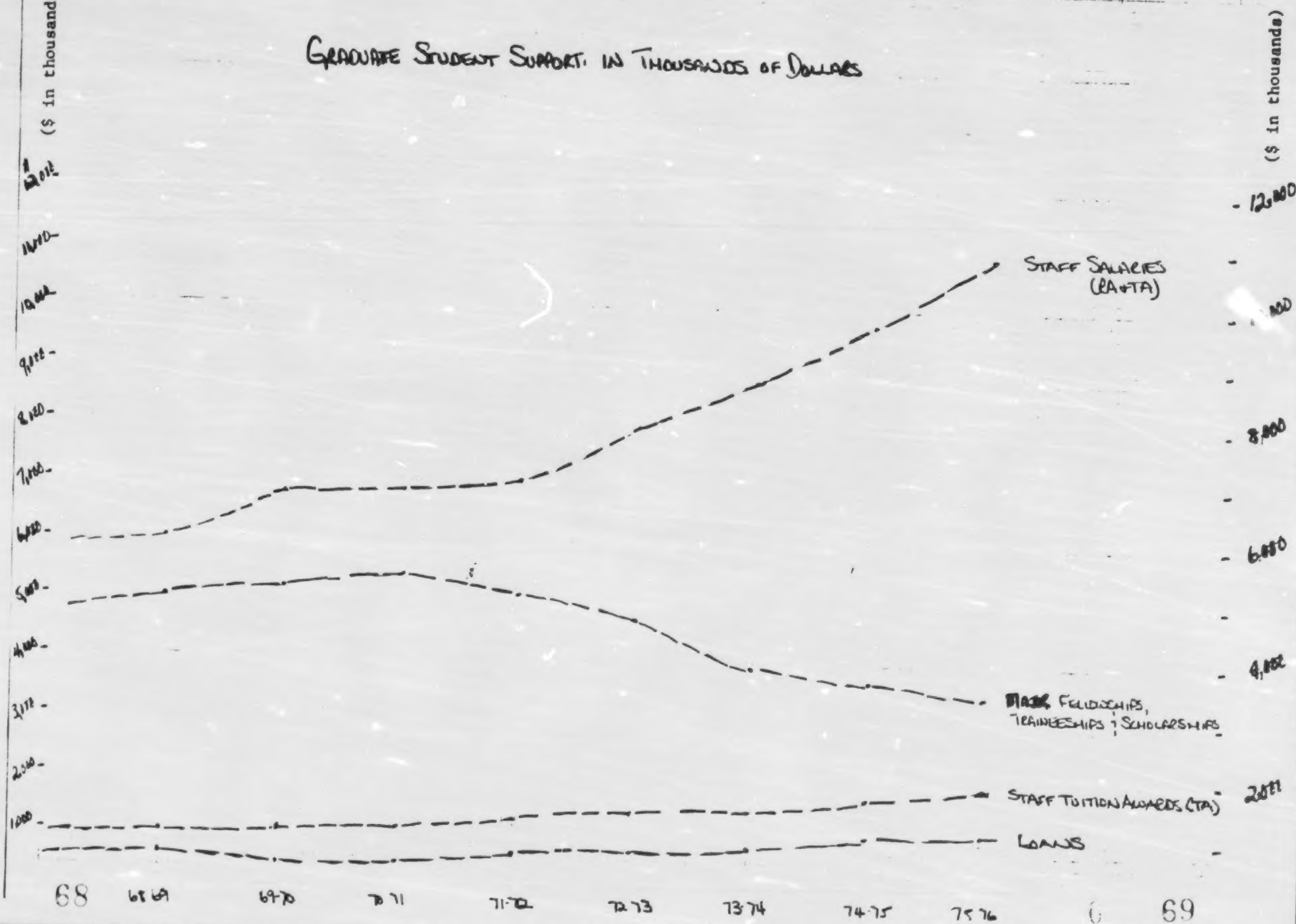
Departments were affected quite differently by these cutbacks. Some, like the Biology Department, were relatively unscathed. Its major source of funds, the NIH Traineeships, continued at their historical levels, while the introduction of the Cancer Center produced a number of new research assistantships. Others, however, were more seriously affected. The Sloan School of Management lost all graduate traineeship support, down from 16 students who were so supported in 1968-69. Fellowships and traineeships in the Mechanical Engineering Department fell by a third. Both departments responded by offering students research assistantships. In fact, this pattern has been repeated throughout the Institute. As Chart 1 shows, staff salaries (research assistantships and teaching assistantships) have become increasingly important sources of graduate student financial aid. We have already pointed out that research assistantships account for the largest proportion of that category, and have been steadily increasing since the early 1970s (see Table 6). Loans, too, have become more important, as students

Table 6

Graduate Student Staff, 1967-68 to 1975-76

	Research Assistants		Teaching Assistants		Other		Total
	No.	%	No.	%	No.	%	
1967-68	1,109	70	462	29	15	1	1,586
1968-69	1,061	68	494	32	--	--	1,555
1969-70	1,118	69	509	31	--	--	1,627
1970-71	996	66	505	34	--	--	1,501
1971-72	964	67	481	33	--	--	1,445
1972-73	1,036	68	482	32	--	--	1,518
1973-74	1,073	68	502	32	--	--	1,575
1974-75	1,142	71	462	29	--	--	1,609
1975-76	1,366	76	438	24	--	--	1,804

Chart 1


GRADUATE STUDENT SUPPORT IN THOUSANDS OF DOLLARS
($ in thousands)
($ in thousands)
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1000
12,000
8,000
6,000
4,000
2,000
STAFF SALARIES (RA+TA)
MAJOR FELLOWSHIPS, TRAINEESHIPS & SCHOLARSHIPS
STAFF TUITION AWARDS (TA)
LOANS
68-69
69-70
70-71
71-72
72-73
73-74
74-75
75-76

Amounts of Graduate Student Support*

	Fellowships Traineeships Scholarships	Staff Tuition Awards (TA)	Staff Salaries (RA & TA)	Loans
1968-69	$ 4,994	$ 1,033	$ 6,015	$ 646
1969-70	5,197	1,056	6,815	470
1970-71	5,396	1,182	6,850	483
1971-72	5,076	1,294	7,086	696
1972-73	4,687	1,432	7,991	754
1973-74	3,930	1,453	8,781	852
1974-75	3,693	1,738	9,760	1,075
1975-76	3,447	1,878	10,878	1,141

*All amounts are in thousands of dollars have been forced to borrow in order to finance their graduate educations. The dollar volume of loans has risen over 100 percent between 1968-69 and the present.

RESEARCH

As a leading research univeristy, M.I.T. is heavily dependent on federal support of science and technology. Much of the Institute's growth has stemmed from the infusion of federal funds. Sponsored research occupies a large proportion of faculty time, and departments regularly charge some percentage of faculty salaries to such projects. A wide variety of interdepartmental centers and laboratories have developed since 1945, each focusing on research in a specialized area. Those centers, which have full-time staffs as well as associated faculty. are one of the special features of research at M.I.T. In addition, Lincoln Laboratory (a federally funded research and development center) and Draper Laboratory (ultimately divested in 1973), both large, well-known research centers comparable to Lawrence Livermore and similar laboratories, have long been associated with the Institute.

Table 1 gives some indication of the volume of research at M.I.T., and the percentage that is sponsored by the federal government. Those revenues can be compared with the Institute's 1976 operating expenses of $269,250,000. Of that total, nearly 70 percent was funded through sponsored research (campus and Lincoln Laboratories). Federally funded research alone generated 63 percent of the revenues.

The volume of sponsored research at M.I.T. was quite small

Table 1

Volume of Sponsored Research, 1972-76

A. Campus

	Federal Government		Other Sponsors		Total Expendit.
	$	% of all Spon. Rsch.	$	% of all Spon. Rsch.	
1972	$59,822,927	85.4	$10,206,535	14.6	$70,029,462
1973	$62,532,886	85.9	$10,240,395	14.1	$72,773,281
1974	$64,308,131	84.6	$11,739,183	15.4	$76,047,314
1975	$71,523,743	84.1	$13,549,601	15.9	$85,073,344
1976	$78,524,483	82.9	$16,207,106	17.1	$94,731,589

B. Lincoln Laboratory

1972	$69,569,891	100.0	$ 0	0.0	$69,569,891
1973	$83,227,022	99.99	$21,434	0.003	$83,248,456
1974	$78,626,156	99.99	$10,550	0.0001	$78,636,706
1975	$81,894,553	100.0	$ 0	0.0	$81,894,553
1976	$91,918,966	99.99	$135,397	0.001	$92,054,363

C. Draper Laboratory

1972	$47,550,808	98.1	$923,336	1.9	$48,474,144
1973	$62,046,311	97.1	$1,858,852	2.9	$63,905,163

prior to World War II, but grew extremely rapidly during that period. In the years following the war, sponsored research already accounted for a large percentage of Institute revenues. While that percentage has not increased over the years (in fact, it appears to have fallen since the war years), Table 2 shows that the absolute volume of sponsored research has grown dramatically.

The sources of federal support are quite diverse, and differ markedly for different departments and laboratories. The heavy dependence on the Department of Defense (DOD), however, still remains. Fully 93 percent of the research conducted at Lincoln Laboratory is funded by the DOD, and 14 percent of campus-based research. Nevertheless, other agencies have become increasingly important sources of funds in recent years, especially as federal priorities have changed. The Energy Research and Development Administration (ERDA), the National Institutes of Health (NIH), and the National Science Foundation (NSF) now support a large proportion of departmental and interdepartmental research.

There have been several pronounced shifts in federal research and development policy and funding in recent years. Federal support of science and technology, which had grown steadily throughout the 1950s and early 1960s, slowed significantly in the mid-1960s. The average annual rate of increase in government R and D funding (constant dollars) averaged 11.3 percent from 1953-1961, 6.3 percent from 1961-1967, and -1.0 percent from 1967-1975. Federally-funded graduate fellowship and traineeship support has been similarly curtailed.

Table 2

Operating Expenses and Sponsored Research, 1949-50 to 1974-75

	Total Operating Expenses	Sponsored Research	
		$	% of Total
1949-50	$ 43,043,000	$ 38,659,000	88
1954-55	$ 47,291,000	$ 32,488,000	68
1959-60	$ 92,018,000	$ 66,550,000	71
1964-65	$175,659,000	$140,425,000	80
1969-70	$217,703,000	$171,294,000	79
1974-75	$237,149,000	$169,756,000	71

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Accompanying the cutbacks in federal support have been shifts in the nature of the research being funded. Federal agencies have moved increasingly toward projects of shorter duration, whose relevance to pressing social problems (e.g. energy, environmental protection, transportation) is more readily apparent. In addition, reporting and oversight requirements have expanded, with accompanying increases in paperwork and time devoted to agency contact.

These observations apply at only a highly aggregate level. As such, they are somewhat misleading, because they mask significant differences among institutions and among individual departments within institutions. In the following pages we describe the impact of federally-funded research on M.I.T. in somewhat greater detail, and analyze the responses of four different departments. Those departments - Biology, Mechanical Engineering, the Sloan School of Management, and the Research Laboratory in Electronics - were chosen because they reflect, in microcosm, the wide range of functions that research has played at the Institute, and the various adaptations that have been made to accommodate changes in federal policy or support in recent years.

I. The Institutional Impact

A. Research Administration: The large volume of sponsored research conducted at M.I.T. has necessitated the development of a large in-house research bureaucracy. That organization, the

Office of Sponsored Programs (OSP), consists of 17 professionals (a Director, an Associate Director, 11 Assistant Directors, and 4 Coordinators) and a supporting staff of 11 or 12. It is fully funded by the indirect cost component of research contracts.

OSP reviews all research proposals, checking to see if the budget tallies, if travel expenditures meet federal requirements, if the regulations governing the use of animals, human subjects, and recombinant DNA have been observed, and, more generally, if all requirements of the sponsoring agency have been met. Any project posing special problems or having a budget over $75,000 goes to the Provost for final approval, while any project over $250,000 goes to the Vice-President for Financial Operations. For projects posing no special problems, this review takes only one or two days; for others, especially those with larger budgets, the period may extend to three or four days. After final approval by OSP the proposal is sent out to the sponsoring agency. Should it be accepted, OSP then authorizes an account for the project and monitors expenditures for its duration. Any changes in the authorized budget must be approved by OSP. Finally, the office monitors the closing out of all projects, insuring that the final report is submitted, and that such matters as property and patents are attended to.

OSP's role, then, is that of an administrative overseer. It does not attempt to market or solicit research proposals, but only to insure that they meet all requirements of the sponsoring agency.

It does, however, negotiate the terms of annual basic agreements covering all research from particular agencies (e.g. DOD, ERDA). Those agreements involve such things as publication rights, patent rights, and scope of work provisions. In addition, OSP is responsible for monitoring the financial accounts of all on-going research projects.

Despite the existence of the OSP, many professors complain bitterly about the increasing paperwork attached to research proposals, grants, and contracts. While the OSP oversees all grant application and reporting, it does not participate in the research process directly. Professors are responsible for completing all necessary forms and reports, and with communicating with the sponsoring agency as required. Of the professors surveyed, several estimated that they now spend between 20 and 25 percent of their research time in these activities. All objected strongly to the increased paperwork demanded by most sponsoring agencies.

One solution to this problem is that of the Research Laboratory in Electronics (RLE). In addition to the usual costs of research, RLE adds to each proposal a 15 percent charge for "allocated project level costs." That charge covers all RLE services, including assistance in the preparation of budgets, detailed monitoring of project expenses and the use of shops, machinery and other support services. Most important, the RLE staff handles all paperwork and most agency contact. Professors have responded enthusiastically to the system because it considerably reduces the administrative burdens of conducting research, while sponsoring agencies have not objected to the considerably reduces the administrative burdens of conducting research, while sponsoring agencies have not objected to the increased project costs. Why other departments have not adopted a similar strategy is not at all clear.

B. Indirect Costs: The Institute identifies three general categories of costs. Direct costs of instruction and unsponsored research include faculty, staff, and support salaries, materials, supplies, and all other costs that can be attributed directly to instructional programs. Similarly, direct costs of sponsored research include only those costs that can be ascribed directly to sponsored research activities. The last category, shared indirect costs, includes all those activities which support both instruction and research and cannot readily be assigned to either one. These include academic administration, libraries, physical plant, employee benefits, and similar items. The inclusion of some of these as costs legitimately attributable to research (e.g. employee benefits) is quite problematic.

Because shared indirect costs reflect both instructional and research activities, some mechanism must be developed to distribute charges between the two categories. Various formulae have been negotiated with the federal government under guidelines contained in Federal Management Circular No. 73-8 (originally issued by the Bureau of the Budget as Circular A-21). These formulae, when applied to different classes of expenses, yield a figure for the shared indirect costs that can be assigned to research. This portion of shared indirect costs is then paid by the sponsoring agency through an indirect cost rate (the overhead rate) for which the base is the salary and wage component of the direct costs of research.

We do not intend to enter the debate over the appropriateness of the various formulae used to calculate indirect costs, nor will we consider whether universities over-or-under-recover the shared indirect costs that result from research. However, several observations are important. Table 3 presents data on indirect cost recovery rates at M.I.T. in several major cost areas, and illustrates the large proportion of those costs borne by research. Those figures further underscore the importance of research at M.I.T., and the pressures to maintain a continuing high volume of sponsored research. Should research volume fall, reimbursement of indirect costs would fall as well. Actual indirect costs, however, are unlikely to fall as sharply, at least in the short-run. Instead, the fall-off is more likely to follow a step function, because of the large element of fixity in indirect costs. For example, the costs of library operation are unlikely to be dramatically reduced by a cutback in federally-funded research. Most staff would probably be retained, with only minor changes in maintenance and support services. This is an especially serious problem with personnel, who are in some sense a fixed investment that cannot be readily curtailed should research contacts be reduced. As a result, the actual costs of operation would probably continue at roughly similar levels while the costs borne by the federal government (through the indirect cost component of research grants and contracts) would have fallen. This appears to have been a particularly serious concern in the early 1970's, when federal R and D support was sharply reduced, and probably

Table 3

Research Indirect Cost Recovery Rates of the Larger Cost Areas

(Actual/Budget Net Rate After Underrecovery)

	1960 Actual Net %	1965 Actual Net %	1967 Actual Net %	1969 Actual Net %	1970 Budget Net %	1971 Budget Net %	1972 Actual (1) Net %	1973 Budget Net %	1974 Budget (2) Net %	1974 Budget (3) Net %
Academic Administration	45	61	58	59	59	58	60	62	61	56
Library	46	55	54	55	55	54	55	55	51	47
Normal Plant	69	73	65	63	64	63	67	68	61	57
Other Plant	69	73	65	63	64	63	67	68	61	57
General & Administration	78	80	75	74	74	74	77	78	74	68
Use of Facilities	65	72	65	63	64	63	67	68	61	57
Employee Benefits	(4)75	(4)75	(4)75	(4)75	(4)75	(4)75	(4)75	(4)75	(5)69	(5)69

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Table 3, (cont.)

Notes

(1) Reflects 1972 fiscal actual unaudited recovery rates.

(2) Reflects 1974 fiscal budgeted recovery rates net of normal underrecovery and cost sharing. Recovery rates also reflect impact of Draper salaries being excluded from the formula.

(3) Same as #2 but in addition it reflects impact of divestment rate ceilings.

(4) Approximate recovery ratio of benefits. This reflects direct and indirect recovery from sponsored research. Recovery from government sponsored research is approximately 72%.

(5) Approximate recovery ratio of benefits. This reflects both direct and indirect recovery from sponsored research net of Draper Lab participation.

contributed significantly to M.I.T.'s financial difficulties at the time. Since these shortfalls have to be made up from Institute funds, there are strong pressures to maintain existing research volume to avoid such problems.

Faculty, however, often see the issue somewhat differently. A number of professors surveyed complained about the high cost of conducting research at M.I.T., a cost they attributed to the Institute's method of calculating the overhead rate. While comparisons of the costs of conducting research at different institutions are difficult, it appears that M.I.T. projects are often more costly than identical projects conducted elsewhere. Whether this has resulted in an inability to win grants that would otherwise have been awarded is not at all clear. In addition, departments sometimes object to the uses of the funds that result from indirect cost recovery. Those funds are not earmarked, and may be allocated by the administration where needed. Professors in the Schools of Science and Engineering, who generate these funds through their grants and contracts, occasionally complain that they are not receiving their fair share. Instead, they argue, the funds are being used to support departments in the School of Humanities or Social Science which generate little sponsored research of their own.

A number of professors commented on the pressures imposed by the administration to maintain research volume. Because few alternative sources of increased income are available, the Institute must maintain the existing high level of research funding in order to support its many programs. As a result, large federal awards are often viewed as necessary for continuing the normal operation of many departments. When their funding ceases and the department requests a corresponding increase in its academic budget, to be provided from general revenues it often meets considerable resistance, with the administration encouraging the department to secure additional awards to compensate for those that have been lost. As a result, departments often feel under pressure to maintain or increase the volume of sponsored research, especially when faced with rising enrollments. Without those funds, MIT would be a totally different institution, with far fewer programs and significantly less research.

II. Departmental Impacts

A. Research Volume: The ability to secure federally-funded grants and contracts varies widely throughout the Institute. Some departments (e.g. Biology) report a steadily rising research volume, with most faculty supported at desired levels. Despite the cutbacks in federal support, they have found grants to be only marginally more difficult to get. Others (e.g. RLE) report increasing difficulty in securing the desired level of funds. Multiple applications (with the same project proposal being sent to several sponsoring agencies) have become more common. In addition, there has been an overall reduction in the number of active experiments conducted there, a general shrinkage in the size of experiments (as measured by dollar volume of the grant or contract), and a cutback in the length of most projects.

In general, top quality research has little difficulty being funded. This appears to be especially true of tenured faculty who have already established reputations in a field. Several of them commented that over the course of ten or fifteen years they had personally experienced few problems in securing desired research funds. Many had developed long-standing relationships with particular agencies, agencies which regularly reviewed and approved their project proposals.

Other professors have not been as fortunate. Several commented on the increased difficulty of securing funds for basic research. Shifting federal priorities have had a major impact on the type of research now being funded, with much more attention now devoted to applied research, often related to pressing social problems. As a result, several professors admitted to shifts in the nature of their own research, reflecting in part the availability of funds in these areas. While none felt that his interests had altered solely because money was now available in a different field, most acknowledged its impact on their perceptions of what research topics were interesting, important, and worth pursuing. The availability of funding appears to play a particularly important role in the decisions of young faculty, many of whom choose their areas of research with an eye toward the future, hoping to begin work in a field which will continue to attract funds in later years. In addition, young professors have the flexibility to direct their research into any of a number of possible channels, and so can more smoothly shift direction in anticipation of new sources of funds.

Some departments, however, are forced to rely on other than federal sources of funds because little money is available in any areas of interest. The Sloan School, for example, has found it extremely difficult to secure federal support in desired areas. Increased federal funding in areas of social relevance has meant little attention to strictly private sector questions. Few funds are available in the traditional business fields of marketing, finance, production and distribution systems, and management science, with the scarcity particularly serious in those areas of research touching on basic methodological issues (e.g. areas of mathematical analysis including programming theory, stochastic processes, probability and statistics). As a result, much of the Sloan School's research remains unsponsored (especially its basic research) or else supported by foundations or industry. Because most industry-funded projects are of short duration and narrowly targeted (and often difficult to distinguish from outright consulting activities), they are not always viewed as desirable. The upshot is that the department would, in fact, like to increase its volume of federally funded research, because the funds available from other sources do not always take the desired form.

B. Assessments of Sponsoring Agencies: A number of professors expressed reservations about the mission-oriented agencies, likening their projects to consulting activities for the federal government. With the desired ends clearly specified by the agency, little freedom is available to pursue independent interests. One young professor bombarded by directives from Washington, complained that he sometimes felt more like a Boston-based NASA employee than an M.I.T. faculty member.

Mission-oriented work is also vulnerable to charges of "competitive optimism." Contracts are sometimes awarded to those researchers who make the grandest promises, promises that may bear no relation to attainable goals. Because these assessments are unreasonably optimistic, researchers then devote considerable effort to extricating themselves from the promises made and scaling down the scope of work. At the same time, other researchers who presented more realistic project proposals will have lost out, prompting the complaint that grantsmanship is occasionally more important than substance.

Not unexpectedly, those agencies that imposed the fewest constraints were viewed most favorably. While some professors voiced philosophical objections to DOD research, several actively preferred working for the military citing the availability of funds for basic research, DOD's ability to make independent decisions without lengthy peer review, and the absence of massive paperwork and documentation. In the aftermath of the Mansfield Amendment, however, they noted that DOD has moved to tighten its control, and no longer supports as wide a variety of projects. NSF, too, was well received, and for many of the same reasons. Its willingness to support basic research and its minimal reporting requirements were frequently cited. On the other hand, several professors of engineering, citing bad experiences of their own, complained that NSF's peer review system had become dominated by a small clique of professors, making it difficult to receive funds for projects outside their sphere of interests. These criticisms, however, were the exceptions; most professors commented quite favorably on the peer review system.

Of all the agencies discussed only ERDA was consistently criticized. Most professors regarded its reporting requirements as excessive (with monthly reports often expected), its oversight as somewhat heavy-handed, and its contract demands as overly detailed. Nevertheless, ERDA now controls a great deal of federal research and development money, and accounts for approximately 14 percent of campus-based research.

C. The Role of Research: Sponsored research serves a number of functions at the Institute, with great variation across departments. Some rely on grants and contracts as a vehicle for departmental growth, others for attracting top quality assistant professors, and still others for supporting graduate students. All the departments surveyed, however, charged a significant proportion of faculty salaries to research. Senior faculty in the science and engineering departments were expected to devote nearly 50 percent of their time to research, with that proportion of their total salaries paid by outside grants and contracts. Junior faculty were expected to cover a somewhat smaller proportion of their salaries from research projects. The Sloan School, however, was quite different, because few funds are available for research in management, finance, marketing or related fields, either from government or industry. This availability of research funding in desired areas, coupled with the School's initial endowment from the Sloan family (which has kept it solvent in the absence of funded research), has led to its charging a much smaller proportion of faculty salaries to sponsored research.

Some departments have used federal grants and contracts as a means of expanding their faculties, charging a large percentage of the costs of new faculty to such projects. They have relied on the principle that the greater the proportion of a professor's salary that is charged to sponsored research, the smaller the amount required from the Institute budget. This has been especially important during recent periods of financial stringency, a time when budgets have become increasingly tight, growth has been curtailed, and many departments have suffered cutbacks. As a result, those departments that have been able to fund a significant proportion of salaries through sponsored research have met the least resistance from the administration in adding new positions. For example, both Biology and Mechanical Engineering have experienced sharply increasing undergraduate enrollments in recent years. Both perceived the need for additional professors to absorb the increased teaching loads. Only the Biology Department, however, has been able to expand; its faculty grew from 29 in 1971-72 to 37 in 1975-76. In contrast, Mechanical Engineering has actually suffered a reduction in faculty, falling from 56 in 1971-72 to 46 in 1975-76. The explanation appears to lie in the founding of the Cancer Center in 1972 and the accompanying infusion of funds. That Center has attracted a large volume of sponsored research, funds which have permitted its associated faculty - most of whom are also members of the Biology

Department - to charge roughly 75 percent of their salaries to research. As a result, the Institute has had to provide relatively little to support the new professors of biology, especially in comparison to the amount that would have been required to fund a similar expansion in Mechanical Engineering. The latter has been unwilling to employ the same strategy, believing that the laboratory structure, with its heavy reliance on technical staff, would dilute the educational functions of the department. In addition, funds today are much more readily available in health-related fields than they are in engineering.

Other departments also rely on sponsored research to help fund new positions. In fact, some regard it as the critical element in their ability to attract qualified young faculty. For example, the core contract of the Research Laboratory in Electronics, awarded by the Joint Services, provides funds for approximately 25 faculty members each year, many of them recently hired professors of physics or electrical engineering. The Joint Services contract is largely a block grant, with much discretion left to the Laboratory in how the money is to be employed. RLE has chosen to use the funds primarily as "seed money" to get new projects started or new professors equipped. Incoming faculty are provided with salary and equipment support from the Joint Services grant, often supplemented by Sloan grants awarded by the Institute. These packages generally average $75,000 and enable departments to offer young professors a fully-equipped laboratory, together with funds to support several post-doctoral students or research assistants for a short time.

The provision of laboratory facilities and the ability to begin research immediately upon arrival are important selling points for M.I.T. Attracting federal funds is a time consuming activity, especially for young professors with little research experience. Equipment grants are especially difficult to get, and often require matching funds from the institution. As a result, in recent years a large number of the best young Ph.D.s in physics and electrical engineering have joined industrially-supported research laboratories (e.g. Bell Laboratories, IBM, Xerox) where the most advanced equipment is readily available. Thus, the Joint Services grant has served the important role of enabling M.I.T. to offer a research environment comparable to that of the industrial laboratories.

Sponsored research offers advantages to established faculty as well. Increases in the volume of sponsored research often mean commensurate reductions in teaching loads. For example, the Sloan School's Management Science Group requires all professors to teach two courses each term, unless they generate high levels of sponsored research. A large volume of outside research frees them from teaching that would otherwise be required.

D. The Support of Graduate Students: Graduate students, too, have benefited from the Institute's sponsored research. Many are supported as research assistants, participating in projects that will culminate in doctoral dissertations. Table 4 gives some indication of the importance of research assistantships in the

Table 4

Research Assistantships, 1967-68 to 1975-76

	Total Awards to Graduate Students	Research Assistants	
		No.	% of Total
1967-68	3,045	1,109	36.4
1968-69	2,962	NA	NA
1969-70	3,001	1,118	37.3
1970-71	2,897	996	34.4
1971-72	2,760	964	34.9
1972-73	2,810	1,036	36.9
1973-74	2,796	1,073	38.4
1974-75	2,903	1,142	39.3
1975-76	3,136	1,366	43.6

M.I.T.

support of graduate students. Their importance has been growing since the early 1970s as federal fellowship and traineeship support have been cut back. Over 40 percent of all graduate students at M.I.T. who receive financial aid are now funded through research assistantships.

Once again, these trends mask great differences among departments. The Sloan School, like most other schools of management, supports few of its M.B.A. candidates but nearly all of its doctoral students. Because federal fellowships are seldom available in management-related fields, Sloan relies heavily on research assistantships to support its students. Increases in the volume of sponsored research enable the department to offer aid packages to a larger number of applicants, as well as permitting better offers to each candidate. These offers have undoubtedly increased the attractiveness of the Sloan School and its competitiveness with other high-ranking business schools.

Other departments have not been as fortunate. Mechanical Engineering, for example, has relied increasingly on research assistantships to support its graduate students. In the process, two problems have had to be faced. Other institutions (especially Stanford, one of the wealthiest of the private universities), with departments of comparable quality, have offered candidates fellowships rather than research assistantships. Those fellowships provided by those institutions out of their own funds are generally viewed as more desirable than research assistantships, and as a result, have drawn some of the most qualified applicants to other schools. In addition, the department has faced a difficult sequencing problem. Graduate school acceptances and the accompanying offers of financial aid must be mailed in March or April, while federal contracts and grants may not be awarded until several months later. For several years the department was forced to offer some incoming students provisional guarantees of financial aid (i.e., should Project X be funded, the student would be provided with a research assistantship in his desired field). Again, this led to a number of the best applicants enrolling in other schools. The department responded by pooling research funds in order to make pledges of financial support to the best applicants (even though at the time of the offer the particular form of that support remained uncertain). These measures, coupled with efforts to convince applicants that research assistantships are as desirable as fellowships, have sharply increased the department's yield from the pool of the most highly qualified candidates.

Other departments have not relied as heavily on research assistantships to support graduate students. The Biology Department, for example, supports approximately 65 of its students each year on NIH Training Grants, and only 15 or 20 as research assistants. This reflects the department's view that research assistantships channel students into a particular line of research, and unduly limit their fields of specialization. In addition, sponsoring agencies (notably NIH), well aware of the large number of traineeships offered by the department are often unwilling to fund research assistantships through grants and contracts. As a result, even if the department wished to increased the number of research assistantships offered, it would probably be unable to do so. Few other fields, however, have a similarly high level of traineeship support available.

The number of graduate students in a department is limited by two factors - the size of the faculty (i.e. its ability to supervise doctoral dissertations) and the amount of financial aid available (i.e. the ability to support graduate students through four or five years of study). Both bear a close relation to the volume of sponsored research generated by the department. For example, the greater the proportion of faculty salaries charged to research projects, the easier it is to support a larger staff. The same amount of Institute funds supports a larger number of professors. Similarly, the higher the volume of sponsored research, the more research assistantships available, and the larger the number of graduate students that can be supported. Evidence from the surveyed departments confirms these observations; in each, the level of sponsored research, the number of faculty members, the number of graduate students, and the number of research assistants frequently move together.

III. Summary

First and foremost, M.I.T. is a research institution. As such, it depends heavily on federally-funded research, and is quite sensitive to major shifts in federal policy. Yet it has shown a remarkable flexibility in adapting to the vagaries of federal funding, and a willingness to change to meet emerging priorities. In addition, MIT has helped to set many of these priorities, and has had an important influence on federal science policies. While sponsored research plays a variety of roles at the Institute, varying sharply by department, most have managed to adjust to recent changes in federal research and development policy without undue hardship. Nevertheless, the necessity of that kind of rapid adaptation must be emphasized. Because M.I.T. depends so heavily on federally funded research, an inability or unwillingness to respond to changes in federal research, and development policy would have serious implications for individual departments and for the university at large.

SAFETY, HEALTH, ENVIRONMENTAL PROTECTION, AND ANIMAL CARE

In recent years the federal government has issued a number of regulations governing the nature and use of physical facilities. While often aimed primarily at industry, these regulations apply with equal force to universities. They appear to have been motivated by a concern that areas such as safety and health were often given low priority by the private market, or provided in sub-optimal amounts, thus justifying federal intervention. As a result, several new regulatory agencies were established, while some existing agencies were granted further authority. These agencies, in turn, now issue and enforce a large body of codes and standards. They can be conveniently discussed under four general headings - safety, health, environmental protection, and animal care.

I. Safety

A. Regulations: The Occupational Safety and Health Act was enacted in 1970 in order to standardize and enforce safety and health practices throughout the United States. Its aim was "to assure safe and healthful working conditions for working men and women" and was directed at all enterprises that engage in activities affecting interstate commerce. An Occupational Safety and Health Administration (OSHA) was created under the act, with broad powers to develop standards, conduct inspection, and levy fines to insure employer compliance.

B. The M.I.T. Response: M.I.T. has had a formal safety program for more than 25 years. The cornerstones of that program have been the Safety Office, staffed by certified safety engineers who advise members of the Institute on acceptable safety practices, and a Safety Committee, consisting of representatives from faculty, staff, and administrative ranks as well as members of the Safety Office. That committee meets regularly to establish Institute-wide safety policy.

After OSHA was established, the Safety Committee met to determine an appropriate response to the newly issued regulations. At the time the Safety Office had a staff of between 8 and 10, which was considered insufficient to oversee compliance with the large number of detailed regulations issued by the agency. In addition, M.I.T.'s safety engineers believed that their time would be better spent monitoring potentially more serious hazards (in laboratories, for example) not covered by OSHA. As a result, the Safety Office was directed to publicize the new standards through a series of newsletters, without actually seeking to enforce compliance.

In October, 1972, a graduate student in physics was electrocuted in an M.I.T. laboratory, precipitating a full-scale inspection by OSHA compliance offices. M.I.T. was the first university to be so investigated. The inspectors spent three weeks reviewing approximately one-third of the campus. Six weeks after the inspection a citation was issued, citing M.I.T. for 1651 instances of safety violations, including 47 instances of one serious violation (failure to guard against accidental contact with 50 volts or more) and multiple instances of 66 non-serious violations. M.I.T. was ordered to pay a fine of $1775 and to correct all violations within a specified period of time. In addition, the Institute was warned that if similar, though yet undetected violations were found in future inspections, they would be regarded as "willful", and therefore subject to an automatic $1000/day fine.

By August, 1973, the original 1651 violations had all been corrected. In addition, the Safety Office had begun a program to inspect all campus facilities for possible violations of OSHA standards. Those inspections, coupled with the required paperwork, occupied M.I.T.'s safety engineers nearly full time for two years.

Table 1 presents a detailed breakdown of the costs of complying with OSHA (although we emphasize that most figures are only estimates). The bulk of the funds came out of the Institute budget in the form of special allocations to the Safety Office and Physical Plant for the upgrading of facilities. An additional $75,000 was spent by academic departments and laboratories from their own budgets. Most of these costs were non-recurring.

OSHA requirements have now been fully integrated into the Institute's safety program. As a result, the costs of complying with OSHA can no longer be differentiated from other safety program costs. The annual operating budget of the office was $180,000 in 1977, with $50,000 more allocated for upgrading facilities and other special projects. However, the Safety Office estimates that an

Table 1

OSHA Compliance Costs, 1970-1976

Date	Nature of Expense	Cost	
1970	No Impact	$0	
		1970 total:	$0
1971	Record keeping	$75	
		1971 total:	$75
1972	Record keeping	$150	
	OSHA Information bulletins issues	$1,000	
	Inspection by OSHA compliance officers	$7,000	
		1972 total:	$8,150
1973	Record keeping	$150	
	OSHA inspections conducted by the Safety Office	$54,500	
	Upgrading of physics laboratory	$60,000	
	OSHA fines	$1,750	
	Budget allocation for special needs of academic departments	$60,000	
		1973 total:	$176,400
1974	Upgrading of facilities because of citations (1973-1974)	$97,000	
	Record keeping	$150	
	OSHA inspections conducted by the Safety Office	$50,000	
	Budget allocation for special needs of academic departments	$120,000	
		1974 total:	$244,150
1975	Record keeping	$150	
	Budget allocation for special needs of Physical Plant and academic departments	$30,000	
	OSHA inspections conducted by the Safety Office	$20,000	
		1975 total:	$50,150

Table 1, (cont.)

Date	Nature of Expense		Cost
1976	Record keeping	$150	
	Budget allocation for special needs--OSHA inspections, space changes, and new construction	$30,000	
		1976 total:	$30,150
1973-76	Expenditures by departments and laboratories for upgrading of facilities	$75,000	
	Grand total:		$584,075

additional $30,000-40,000 will be required annually to renovate facilities in order to insure continued compliance with the standards.

C. Assessment: M.I.T.'s safety engineers do not believe that the OSHA inspection was especially thoroughgoing. In many cases the compliance officers were not at all knowledgeable about the sophisticated scientific equipment being employed in various labs, and so were unable to assess their safety. In addition, OSHA standards often involve "bread and butter" safety practices, difficult to argue with, but often less consequential than other safety problems encountered here at the Institute. As a result, most violations cited by the inspectors were minor infractions. Of the 1400 laboratory violations, some 400 involved the improper mounting of fire extinguishers (even though M.I.T. had a sufficient number of fire extinguishers, some were unmounted, while others were not mounted the correct distance from the floor). Another 400 involved unsecured gas cylinders, while 300 more involved unguarded belts on laboratory vacuum pumps. Though minor, these violations had to be corrected, and the Safety Office had to conduct further inspections to insure that similar violations did not exist in other buildings. This diverted their attention from the more serious safety issues to which they would rather have devoted their time, and considerably limited their ability to exercise independent judgment in what safety problems were of critical importance. In fact, two additional safety officers were hired by M.I.T. for the sole purpose of conducting OSHA-type inspections throughout the Institute.

On the other hand, the OSHA inspection, citation, and enforcement of standards has had some beneficial effects. The Safety Office acknowledges a dramatic increase in the "safety consciousness" of M.I.T. personnel after the inspection. Faculty, students, and staff seem far more aware of safety issues, and are more likely to seek out advice on good safety practices. In addition, the Safety Office notes that it now has far more leverage in dealing with researchers than it did prior to OSHA. When queried about safety practices, the office can now respond that certain precautions are required by law, which carries more weight than a mere suggestion. This is especially important at M.I.T., where the Safety Office is only an advisory body, and the final responsibility for safety lies with the individual worker/researcher and his immediate supervisor. Thus, the position of the Safety Office has been considerably strengthened as a result of OSHA.

Tables 2 and 3, which illustrate trends in the incidence of work-related injuries at M.I.T., give some indication of the impact of OSHA. They indicate a fairly steady growth in accidents through 1972-73, and then a sharp decline immediately thereafter. While it is difficult to disentangle the impact of the OSHA inspection, citation, and subsequent investment in safer facilities from other forces, it is likely that OSHA was largely responsible for the reduction in the accident rate. The degree to which this reflects safer facilities, the increased awareness of safety issues displayed by workers and researchers, or the greater leverage exercised by the Safety Office is not at all clear.

Table 2

Incidence of Disabling Injuries at M.I.T., 1953-1970

Year	# of Employees	# of Disabling Injuries	Disabling Injuries per 100 Employees
1953	6,299	61	.97
1954	6,504	67	1.03
1955	6,244	70	1.12
1956	7,128	66	.93
1957	7,504	80	1.07
1958	7,484	98	1.31
1959	7,201	109	1.51
1960	7,714	124	1.61
1961	8,188	115	1.40
1962	8,918	138	1.55
1963	9,765	136	1.39
1964	10,089	140	1.39
1965	10,675	179	1.68
1966	10,852	160	1.47
1967	11,425	201	1.76
1968	11,386	214	1.88
1969	11,602	186	1.60
1970	11,141	201	1.80

Table 3

Incidence of Compensated Injuries at M.I.T., 1968-69 to 1976-77

Policy Year	# of Compensated Injuries per 100 Employees	$ Losses Valued as of Jan. 1976	Losses per 100 Employees	# of Employees
1968-69	1.97	144,497	1269	11,386
1969-70	1.95	221,343	1908	11,602
1970-71	2.01	207,377	1899	10,919
1971-72	1.94	169,361	1526	11,100
1972-73	2.24	332,718	3319	10,022
1973-74	1.41	179,542	2183	8,222*
1974-75	1.44	207,747	2499	8,313
1975-76	1.72	159,529	2096	7,609
1976-77	1.40(9 mo.)	100,655(9 mo.)	1369	7,351

* 7-1-73 Divestiture of Draper Laboratories. Note that this is unlikely to have led to the reduction in the injury rate per 100 employees, since Draper was one of the safest laboratories on campus.

II. Health

A. Regulations: Federal standards govern the use of a wide variety of hazardous substances, including radioactive, toxic, and biological materials. A number of different agencies issue, implement, and monitor these regulations, creating a patchwork of authority and control. All, however, appear to be guided by the desire to insure safe and healthy working conditions for those employees who must handle such materials, while similarly protecting those in the immediate environment.

B. The M.I.T. Response: M.I.T. has been concerned with the special problems resulting from the use of radioactive materials and toxic substances since the late 1940s. At that time the Occupational Medical Service was established as part of the M.I.T. Medical Department, with a physician, a health physicist, an industrial hygiene engineer, and a chemist as its professional staff. The service has grown steadily since then, and now includes approximately 35 professionals operating in three divisions - the Radiation Protection Office, the Industrial Hygiene Office, and the Biohazards Assessment Office. In 1970 the service was renamed the Environmental Medical Service (EMS) in keeping with its expanded responsibilities. Its annual budget of approximately $850,000 is paid entirely by the central administration.

Each of the three divisions is responsible for different health issues, and deals with different federal regulations. All, however, operate within the same general structure. Individual workers and their supervisors are directly responsible for observing safe laboratory practices, with the offices of the EMS serving largely as consultants, providing technical oversight and advice on health issues. A number of hazard-control committees, including the Reactor Safeguard Committee, the Radiation Protection Committee, the Laboratory Hazards Committee, and a Biohazards Assessment Committee determine Institute-wide policy on these matters. Each includes representatives from the appropriate division of the EMS, as well as members of the faculty, staff, and administration.

1. The Radiation Protection Office (RPO): The RPO was created in 1948, building on the small staff of the Laboratory for Nuclear Science then involved in radiation protection. At that time the office consisted of one health physicist and two technicians. It has grown steadily over the past thirty years, and now numbers 23 people, including 6 health physicists, 14 technicians, and 3 secretaries. That growth has roughly paralleled the increase in the number of labs and researchers at M.I.T. handling radioactive materials.

The use of radioactive materials has been subject to federal regulation for many years, with many of the most important guidelines incorporated in Title 10, Code of Federal Regulations, Part 20. These standards were first issued by the Atomic Energy Commission (AEC) in 1957, and include stipulations on the handling, storage, and disposal of radioactive materials, maximum permissible exposures, and compliance procedures required in order to receive a license to handle such materials. With the dissolution of the AEC in 1975, the responsibility for administering these regulations fell to the newly created Nuclear Regulatory Commission (NRC). The NRC has jurisdiction over all source material, by-product material, and special (fissionable) nuclear material, but has no authority over naturally occurring radioactive material (e.g. radium), particle accelerators, or non-ionizing radiation. Authority over those materials falls to the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), and a variety of state agencies.

Both the Department of Transportation (DOT) and the Energy Research and Development Administration (ERDA) have also issued standards governing the use of radioactive materials. Title 49 of the Code of Federal Regulations, covering the transportation of hazardous substances, has specific provisions for radioactive materials. According to the RPO, these regulations are extremely complex, continually changing, and often very difficult to interpret. As a result the office must spend large amounts of time deciphering the regulations before putting them into practice. ERDA contracts also contain specific provisions concerning the handling of radioactive materials, as well as a detailed list of medical tests required of all researchers using such materials. The RPO feels that many of the medical requirements are far more comprehensive than necessary to protect the health of experimenters.

The RPO has institutionalized a formal review process for insuring the safe use of radioactive materials at M.I.T. Prior to

1957 the Institute required all researchers using such materials to register with the RPO, with careful but informal monitoring of experiments by that office to insure that correct safety techniques were being employed. With the issuance of Title 10, CFR, Part 20, however, the RPO was forced to revamp its procedures to insure compliance with the law. This involved a quantum increase in record-keeping, with far more detailed documentation than had previously been requested. As a result, the office was forced to expand its staff. All researchers interested in using radioactive materials must now register with the RPO, complete a detailed application, and comply with the safety practices required by that office and by the Radiation Protection Committee. The RPO is also responsible for ordering all radioactive material for use at the Institute, for monitoring all incoming and outgoing shipments, and for completing all paperwork necessary to establish compliance with federal regulations.

M.I.T. has an excellent record in the handling of radioactive materials. Since 1948 there have been only two incidents with detectable biological effects, both involving hand exposures. That safety record appears to be more the result of a firm Institute commitment to safety than the direct outgrowth of federally-mandated procedures. From its inception, the RPO has followed a philosophy of minimizing unnecessary exposure to radiation, a policy that has not been altered by federal regulations.

The regulations have, however, had two major effects. First, they have substantially increased the paperwork and documentation required of the RPO. The office estimates that approximately 20 percent of its time is devoted to detailed record-keeping and associated activities that would not have been performed in the absence of federal regulations. As we noted above, this has led to an expanded staff.

Second, the RPO (which many M.I.T. researchers seem to view as an in-house police force) has been able to use the regulations as leverage to promote good safety practices. Because M.I.T.'s license to handle radioactive materials is contingent on researchers throughout the Institute complying with required procedures, the RPO can use this as a prod to those who are reluctant to observe such practices. The office can argue that the carelessness of one experimenter can close down all research with radioactive materials at M.I.T. The fact that the regulations carry the force of law gives the RPO additional authority in its dealings with individual experimenters.

2. The Industrial Hygiene Office (IHO): The IHO was created in the late 1940s as a sub-division of the Occupational Medical Service, in order to insure the proper handling of toxic materials. The office experienced steady growth throughout the 1950s and early 1960s stabilizing at roughly its present size in the mid-1960s. Today the IHO has a staff of 8, including 4 industrial hygiene engineers, 2 technicians, 1 technical assistant, and a secretary.

In the early years of the IHO most regulations governing the use of toxic materials were issued by state authorities. These were generally quite loose, and only weakly enforced. For many years, however, the American Conference of Governmental Industrial Hygienists (ACGIH) has published an annual guide to Threshhold Limit Values (TLV's) for a wide variety of chemical substances and physical agents. While the guidelines have historically been only suggestive, OSHA has recently incorporated a number of TLV's into formal standards, giving them the force of law.

OSHA regulations are of two general types - formal standards (presently applied to a small group of toxic substances including asbestos, vinyl chloride, and mercury) and emergency standards (in force temporarily, and removed as soon as formal standards have been issued). The lag between the issuing of temporary and permanent standards is often quite long, and creates real difficulties for planning. In addition, the IHO feels that many of the emergency standards were issued hurriedly, with little attention to the technical issues involved.

The impact of these regulations must be assessed in the context of M.I.T.'s long commitment to occupational health. The IHO has consistently adopted standards more stringent than those considered the minimum acceptable, and in many cases has anticipated ACGIH guidelines by several years. As a result, the codification of those guidelines into law has had little effect on actual safety practices at the Institute. It has, however, had several side effects. On the positive side, OSHA regulations have increased the awareness of laboratory personnel to the safe use of toxic materials, and have given health issues a heightened visibility at the Institute. Since the IHO serves in a largely advisory capacity, this has increased its effectiveness. On the negative side, M.I.T.'s industrial hygiene officers feel that their ability to exercise independent professional judgment has been reduced by the regulations. In some cases the regulations have had a "dilution effect," making it difficult for the IHO to suggest standards more stringent than those required by law. Researchers seeking their advice are often unwilling to adopt IHO proposed standards that are more strict than those required by law. This result is important, because the IHO believes that a number of OSHA standards are inadequate, and do not limit exposures sufficiently. On the other hand, the IHO regards some of the emergency standards as overly strong, mandating concentrations of materials far below those required for healthy working conditions. Finally, paperwork has increased as a result of the OSHA regulations. The IHO estimates that it now devotes approximately 10 percent of its time to documenting compliance with the standards.

The general picture that emerges is one of often ill-designed standards, increased paperwork and reporting requirements, interference with the independent scientific judgment of the IHO, and long regulatory lag. Offsetting these drawbacks are the greater visibility that the regulations have given the IHO and the increased awareness by the M.I.T. community of the dangers of toxic materials.

3. The Biohazards Assessment Office (BAO): The BAO is a

recent addition to the Environmental Medical Service. A microbiologist was hired within the past year, and a technician is now being sought. In addition, the Institute has budgeted approximately $100,000 to outfit a biohazards laboratory.

Experiments with recombinant DNA have become a highly-charged political issue in recent years, and have provided a major impetus to the creation of the BAO. These issues were first addressed formally in 1974 at the Asilomar Conference, when a number of leading geneticists and molecular biologists drew up a set of guidelines to direct future research in the area. With some modification, those recommendations were incorporated by the National Institutes of Health (NIH) into its set of guidelines which now govern all NIH-sponsored recombinant DNA research, as well as that of other agencies (e.g. NSF, ACS) who have elected to follow them. In Cambridge, they have been enacted into law by the City Council.

M.I.T. has responded to these guidelines by providing the BAO with the opportunity to develop procedures monitoring both laboratory personnel and the immediate environment to insure that all safeguards are met. A Committee for the Assessment of Biohazards has been established here at the Institute to review all recombinant DNA research proposals. The committee consists of the principal investigator, graduate studetns, technicians, physicians, members of the City Health Department, and Cambridge residents.

Because most M.I.T. researchers would prefer as little outside interference with their experiments as possible, the BAO believes that the guidelines have provided considerable leverage in insuring that good safety practices are adopted. They have required the scientists to recognize their obligation to the community in conducting experiments as safely as possible. On the other hand, the office does not believe that any useful purpose would be served by incorporating them into federal law, as Congress is now contemplating. The guidelines are vague in some places, because little factual information is available, and set minimum standards in areas of research are uncertain and subject to revision. Should they be given legal sanction, the BAO would find it difficult to recommend more stringent standards as all that could legitimately be demanded of them. The BAO believes that it is important to preserve flexibility in this area until more is known conclusively about the dangers or lack of dangers of such research.

C. Summary - Safety and Health: M.I.T. has had a strong commitment to occupational safety and health for many years. The existence of the Safety Office and the Environmental Medical Service, both staffed by highly trained professionals, attests to the administration's concern in these areas. Those offices cooperate with a number of safety and health committees to establish institutewide policies on these matters.

Individual researchers, however, often resent the intrusion of these offices, and the additional requirements imposed upon them. They have not always consulted them for advice. In this context, federal safety and health regulations, which put the force of law behind the recommendations of M.I.T.'s safety and health officials, find that detailed standards (with which they do not always agree) increasingly limit their ability to exercise independent judgment or to recommend standards more exacting than those required by law.

III. Environmental Protection: The Environmental Protection Agency (EPA) has issued a number of regulations which have led to modification of M.I.T.'s physical plant. Many of the most important stem from the Clean Air Act and the emissions standards that derive from it. A large fraction of the Institute's incinerators have been shut down because of air pollution standards; those now operated are used only for burning animals and animal-related items. The cost of modifying the remaining incinerators to meet required emissions levels was approximately $15,000. In addition, the cost of purchasing a new incinerator has grown by about $10,000, again due to the tightened emissions requirements.

Boiler plant regulations have also led to increased costs. Approximately $30,000 has been spent on stack gas emissions tests, while an additional $25,000 was required to bring those facilities into compliance. In total, the Institute estimates that approximately $1,500,000 has been spent over the past decade in complying with EPA air quality standards, with the major source of expense being the requirement that M.I.T. burn 0.5 percent sulfur fuel oil.

The Federal Water Pollution Control Act, also administed by the EPA, has had less of an impact. M.I.T. discharges waste water into the Charles River at three points; each outflow must comply with EPA regulations. The Institute has conducted studies of all three, and has shown that the requisite standards were met by existing facilities. No costs were incurred other than those due to the documentation of these findings for the EPA. An important second-order effect has, however, raised costs substantially. The city of Cambridge has recently instituted a system of sewer charges, which this year cost the Institute $170,000. Those charges are necessary if the city is to qualify for federal water pollution control funds. Thus, this expense can ultimately be attributed to EPA regulations.

IV. Animal Care

A. Regulations: The use of animals in research was subject to little control until the passage of the Laboratory Animal Welfare Act (P.L. 89-544) in 1966. That law mandates the provision of proper care and facilities for research animals - including detailed requirements in the areas of power, heat, water, ventilation, waste disposal, and caging standards - and gives the U.S. Department of Agriculture the authority to conduct unannounced site visits to insure compliance. P.L. 89-544 has been amended several times in recent years; in each case, however, the regulations have been tightened.

NIH also requires high standards of animal care. Those standards, set forth in the Guide for the Care and Use of Laboratory Animals, are much more demanding than those of P.L. 89-544, and must be met by all research conducted on NIH funds. In recent years NIH

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peer reviews have paid increasing attention to insuring that experimenters are in compliance with these guidelines.

The Food and Drug Administration (FDA) has recently published its Good Laboratory Practices Act in the Federal Register. That act, soon to become law, incorporates many of the NIH guidelines, while adding several other requirements. While these regulations would initially apply only to FDA-related research, other agencies are expected to adopt them as well.

B. The M.I.T. Response: There has been an enormous growth in the Institute's use of animals for research in the past decade. In 1964 approximately 5,000 animals were purchased; by 1974 that figure exceeded 30,000. An Institute veterinarian was appointed in 1970, although the position initially carried little authority.

In that same year inspectors from the American Association for Accreditation of Laboratory Animal Care (AAALAC) first visited M.I.T. Full accreditation was given in 1972, with the understanding that Institute-wide upgrading of animal facilities would soon be undertaken. That upgrading did not take place, and M.I.T. was placed on probation in 1975. In addition, USDA inspectors had found the Institute to be in non-compliance with P.L. 89-544 the year before. Thus, in 1974-75 M.I.T. was cited by both the AAALAC and the USDA for its substandard animal care facilities, even though it employed a full-time veterinarian. This led to major changes in the procedures for supervising animal care.

Animal care had traditionally been the province of the individual departments, with no one body exercising central control. Efforts were sometimes made to insure proper care, but these efforts were usually viewed as secondary to the main purpose of experiments. As a result, animal care at the Institute was haphazard and disorganized.

After the findings of non-compliance in 1974 and 1975 this system was revamped. A new veterinarian was hired, and control was centralized. The management of all satellite facilities was brought under a newly created Division of Laboratory Animal Medicine (DLAM), with authority over the ordering and care of all laboratory animals at the Institute. The division has grown rapidly in recent years, and now numbers 26-27 people. It also operates its own diagnostic laboratory.

The result has been the provision of higher quality animal care at reduced costs, due to scale economies. The centralization of animal care has proved to be far more efficient than the earlier system. DLAM staff care for all laboratory animals on a continuous basis, with per diem charges assessed on the basis of the estimated costs of caring for different animals. In 1976 these charges (which are paid by individual researchers or by their grants) totaled $365,000, and covered 70 percent of the division's operating budget. The remaining expenses of the DLAM, which consist largely of the salaries of its professional staff, are paid by the administration.

Operating expenses, however, are only a small fraction of the total costs of providing approved animal care. The renovation and remodeling of animal care facilities are extremely expensive. Upgrading all campus facilities to insure compliance with mandated standards is expected to cost $3.5 million (1975 estimates). Of that amount, $150,000 has been provided by an NIH grant and $1.5 million by the NCI. A new animal care facility is also under construction. It will cost almost twice as much (on a square foot basis) as an ordinary building, and will be paid entirely out of Institute funds. The cost of the building, which will provide 13,000 square feet of space, is $1.5 million.

C. Assessment: The federal guidelines on animal care have clearly led to improved care and facilities at the Institute. In addition, they have probably contributed to more reliable experimental results and reduced health hazards for laboratory personnel, neither of which appear to have been goals of the original Laboratory Animals Welfare Act. For example, if animals involved in drug-related or carcinogenic research catch outside diseases or become weakened because of improper care, experimental results might be invalid. Proper facilities also reduce the risk from zoonotic diseases (i.e. animal diseases that may also infect man).

The costs of achieving the gains have been substantial. Expensive renovation and new construction have been required to meet the mandated standards. On the other hand, centralized management and the collecting of animals in larger facilities have led to significant scale economies, resulting in lower per diem costs of care. Record-keeping and reporting requirements have been minimal.

It is unlikely that these efforts would have been undertaken without the prompting of federal regulations. Many researchers consider animal care to be an issue of low priority. As a result, the 1974-1975 findings of non-compliance appear to have been the prime cause of the Institute's upgrading its animal care facilities.

CONCLUSION

Despite the wide variety of federal regulations, M.I.T. appears to have adapted to them without major changes in philosophy or operating policies. While a few regulations have resulted in actions that the Institute would not have undertaken voluntarily, many simply reinforced existing policies or provided the impetus for changes that would probably have occurred at some future time. None, however, has fundamentally altered the character of the university.

In part this reflect M.I.T.'s forward-looking administration, and its willingness to formulate and pursue social goals (e.g. affirmative action, equal opportunity, safety, health) without statutory compulsion. As a result, the machinery for implementing new regulations has often been in place even before their enactment and complying with the regulations has required only minor modifications of existing practices.

This is only true of those regulations which involve procedural requirements. Those that necessitate major capital investments have been much more costly, and have often involved substantial alterations of building plans or existing facilities. Once these investments have been made, however, few other changes have been required. Compliance with OSHA, EPA, and animal care regulations fall into this category.

In contrast to the whole set of federal regulations, federal support of research and development has profoundly affected M.I.T. The Institute is now heavily dependent on federally-funded research, and under considerable financial pressure to maintain existing levels of support. Sponsored research has become the lifeblood of M.I.T., and accounts for a large proportion of the operating budget. As a result, professors are compelled to spend much of their time as "research entrepreneurs," drumming up outside funds in order to keep themselves, their students, and their departments financially secure.

This makes the character of the Institute different in a fundamental way from what it was in the decades before the Second World War; whether or not it is a change for the better is a difficult or impossible question to answer.

APPENDIXES

APPENDIX I: PERSONS INTERVIEWED
APPENDIX II: QUESTIONNAIRES
APPENDIX III: BIBLIOGRAPHY

Appendix I

Persons Interviewed

Chancellor

Vice-President, Dean of the Graduate School

Vice-President for Operations

Vice-President for Administration and Personnel

Vice-President for Fiscal Relations

Vice-President for Financial Operations

Vice-President

Special Assistant to the Chancellor for Minority Affairs

Special Assistant to the Chancellor for Women and Work

Assistant Equal Employment Opportunity Officer

Director of Personnel Services

Assistant to the Vice-President for Administration and Personnel

Director, Office of Sponsored Programs

Research Coordinator, Office of Sponsored Programs

Director of Admissions

Associate Dean of the Graduate School

Assistant Dean of the Graduate School

Assistant to the Dean of the Graduate School

Director of Student Financial Aid

Associate Director of Student Financial Aid (2)

Director of Physical Plant

Director of the Safety Office

Associate Director of the Safety Office

Persons Interviewed (cont.)

Director of the Environmental Medical Service

Director of the Radiation Protection Office

Director of the Industrial Hygiene Office

Director of the Biohazards Assessment Office

Director of the Division of Laboratory Animal Medicine

Chairman, Biology Department

Chairman, Mechanical Engineering Department

Director, Research Laboratory in Electronics

Manager of Financial Planning and Information; Department EEO Officer, Sloan School of Management

Chief Fiscal Officer, Research Laboratory in Electronics

Department EEO Officer, Research Laboratory in Electronics

Department EEO Officer, Biology Department

Department EEO Officer, Mechanical Engineering Department

Department Safety Officer, Research Laboratory in Electronics

Professor of Biology (formerly Department Chairman)

Professor of Electrical Engineering, affiliated with the Research Laboratory in Electronics

Assistant Professor of Electrical Engineering, affiliated with the Research Laboratory in Electronics

Professor of Management, Sloan School of Management

Professor of Mechanical Engineering and Chairman of Department Planning Committee

Administrative Assistant and Program Director for the Masters Program, Sloan School of Management

Appendix II

Financial Aid Questionnaire

1. Level of support. Please provide the following information on student financial aid for the past 10-15 years:
    - a) total financial aid provided
        - 1) federally funded
        - 2) institutionally funded
    - b) costs of attending MIT
        - 1) tuition
        - 2) room and board
        - 3) other (books, travel, etc.)
2. The federal presence. Please provide data of federally-provided student aid for the following programs for the past 5 years:
    - a) campus-based programs
        - 1) Supplemental Educational Opportunity Grants (SEOG)
        - 2) National Direct Student Loan Program
        - 3) College Work-Study Program
    - b) direct student grants
        - 1) Basic Educational Opportunity Grants (BEOG)
        - 2) Veteran's Benefits (GI "bill of rights")
    - c) loans
        - 1) guaranteed loan program
        - 2) federally-insured loan program
    - d) other
3. Responses to changes in the level of federal support. Please indicate how the following have changed (if at all) as a result of the growth in federally funded student financial aid:
    - a) composition of the student body
        - 1) geographical distribution
        - 2) representation of minorities
        - 3) representation of women
        - 4) representatives from lower income families
    - b) percent of the student body granted financial aid
    - c) average level of financial aid provided per student
    - d) tuition levels
        - 1) Is there any connection between the decision to raise tuition and the amount of financial aid available from the federal government?
    - e) number of students enrolled at MIT
4. The federal presence and the decision to award aid. Please comment on any changes in the federal role in each of the following areas, and what the effects have been:
    - a) the criteria for assessing "need": from CSS to the Uniform Methodology-- Has this change affected. . .
        - 1) who receives aid?
        - 2) amounts of aid awarded?
        - 3) paper work (staff and time costs)?
        - 4) data processing (data print-outs required for compliance)?

b) increased regulation and supervision--Has this led to. . .
    1) larger staff of the financial aid office?
    2) increased time devoted to lobbying, testifying in Washington, and communicating with federal officials? If so, how much time is devoted to these efforts?
    3) policy changes in the financial aid office?

5. The nature of federal regulation. Please provide information and comments on the following:

    a) the changing nature of MIT's involvement with the federal agencies funding financial aid
    b) any particularly unreasonable or burdensome regulations
    c) the extent to which federal regulations require your office to do things it would not do otherwise
    d) the extent to which federal regulations have led to improvements in the operation and procedures of your office
    e) the extent to which MIT has benefited or suffered relative to other institutions from any recent changes in the regulations that govern the awarding of federal financial aid

6. Comments. Any general comments you might have on the federal role in the provision and regulation of financial aid would be appreciated.

Departmental Questionnaires

Research

1. The department's overall philosophy toward research, including the following information:

    a) general level of outside support desired.
    b) preferences for different sponsoring agencies, and the reasons for that preference.
    c) the role of federal money: i.e. Is it used to...

        1) promote departmental growth?
        2) hire new faculty, with part of their salaries charged to research?
        3) expand the graduate program by allowing increased support of graduate students as research assistants?
        4) construct new facilities and purchase new equipment?

    d) the level of research volume expected from individual faculty members.

2. Responses to changes in the levels of federal support. If the department has recently suffered from a cutback in federal money or has recently benefited from an increase in federal support, please indicate how the following have changed (if at all):

    a) faculty
        1. absolute number of faculty
        2. balance between federally-supported and unsupported (or reduced support) fields
        3. balance between junior and senior faculty
        4. allocation of faculty time between teaching and research

    b) students
        1. number of undergraduate students in the department
        2. number of graduate students in the department
        3. number of undergraduate students serving as research assistants
        4. number of graduate students serving as research assistants

3. The effects of research. How has the absolute level of federal research and its composition affected the following:

    a) faculty
        1. the ability of the department to attract high quality faculty and research staff:

            a. senior faculty
            b. junior faculty
            c. post-doctoral students
            d. research staff

Research, cont.

2. the amount of time faculty members are expected to devote to soliciting new grants

3. the research topics pursued
    a. Are faculty hired partly because of their fitness for on-going research projects?
    b. Do faculty members find themselves pursuing research in some areas largely because "that's where the money is?"

4. the amount of time (% of total time) professors spend writing up project proposals and progress reports

5. the amount of time professors spend monitoring the finances (budgets) of their research

b) graduate students
1. Has the pattern of federal research had any effect on the dissertation topics selected by graduate students?
2. Is the research program an established part of the graduate curriculum? Has it improved or diminished student-faculty contact? Has the research program (as established by federal priorities) had any effect on the courses offered within the department?

3. Has the absolute size of the graduate program been affected by the levels of federally supported research?

c) undergraduates
1. Has the UROP program been affected by changes in the composition and volume of federally funded research?

Affirmative Action

1. Statistics on the number and percentage of women and minorities at each of the following levels, 1970 to the present"

   a) professors
   b) associate professors
   c) assistant professors
   d) other academic staff
   e) administrative staff
   f) sponsored research staff
   g) exempt
   h) biweekly
   i) hourly

2. Hiring goals for each of the above categories, as presented in the department's affirmative action plans, from the first affirmative action plan to the present one. If goals were not reached, please explain why.

3. Costs of implementing the affirmative action plans, including estimates of the following:

   a) advertising costs
   b) personnel and administrative (time) costs
      1. costs of preparing affirmative action plans
      2. costs of search
      3. costs of complying with changes in the regulations

   (Please see the attached data sheet.)

4. A description of your "serious search" process, including information on the following (using two or three recent searches as examples):

   a) changes in the search procedure that can be attributed to the affirmative action guidelines;
   b) the amount of time spent in search procedures, and the faculty and staff involved;
   c) the number of female and black candidates turned up in recent searches;
   d) the number of female and black faculty and personnel hired.

5. Any general comments on the affirmative action program, including such things as:

   a) drawbacks of the program
   b) strengths of the program
   c) recommended changes
   d) evaluation

Safety and Health

1. When the Occupational Safety and Health Administration (OSHA) inspectors reviewed MIT in 1972, was your department visited? If so, please provide the following information:
    - a) the number and type of violations cited.
    - b) the costs incurred in correcting the violations
        - 1. costs borne by the department
        - 2. costs borne by the Administration

2. Within the past three or four years, the Safety Office has inspected all facilities here at MIT to insure compliance with the OSHA standards. Please indicate:
    - a) the general nature of the upgrading required of your department
    - b) the costs of upgrading your facilities
        - 1. costs borne by the department
        - 2. costs borne by the Administration
    - c) the extent to which your facilities are now fully in compliance with OSHA standards
        - 1. If you are not fully in compliance, please provide an explanation.

3. Has the passage of safety and health legislation and/or the issuance of federal regulations (including those of the NIH, the NRC, the EPA and OSHA) had any impact on experimental work in your department? If so, please indicate which of the following have been affected:
    - a) experiments have been discontinued
    - b) experiments have been postponed
    - c) experiments have become more costly
    - d) safety practices have improved
    - e) awareness of safety issues has increased
    - f) increased consultation with representatives of the Safety Office, the Environmental Medical Service, and the Laboratory for Animal Medicine
    - g) improved safety record

Admissions and Financial Aid

1. Graduate admissions
    - a) levels of federal support
        1. Has the decline in federal fellowship and traineeship support affected the number of graduate students accepted?
        2. Has it affected the candidates the department solicits or accepts (i.e. are fellowship recipients viewed especially favorably?)
        3. How has the department compensated for the decline in federal fellowships and traineeships?
            - a) increased research assistantships offered
            - b) increased teaching assistantships offered
            - c) increased reliance on Institute aid
            - d) increased reliance on outside, non-federal aid
    - b) representation of minorities and women
        1. How many women and minority graduate students have been enrolled in the department, from 1970 to the present?
        2. What efforts (if any) have been made to increase their numbers?

Personnel and Administrative Costs Questionnaire

Instructions

The purpose of the accompanying data sheet(s) is to provide a detailed breakdown of the personnel and administrative costs of complying with various federal programs. Each data sheet applies to a single program, listed at the top of the page. For each program please provide the following information:

A. Tasks: We are interested only in those tasks which are the direct result of federal regulations, and can be clearly attributed to them. These include the design of programs for compliance with regulations, the implementation of these programs, and the monitoring and reporting of results. Some of these costs are start-up costs and are borne only once, while others are recurring, and must be met annually. On a yearly basis, please indicate the various tasks that your office has undertaken as a result of federal regulations, and indicate (with an "X" in the "Nature of Cost" column) whether that task was performed only once or annually. If possible, please include data from 1970 to the present.

B. Staff: For each task listed, please indicate, by title, the people involved in carrying it out, and provide some estimate of the staff time required. Please note that these tasks often involve supporting staff (secretaries, clerks, etc.) in addition to those individuals directly concerned with monitoring or implementing a program. Estimates of the staff time required for each task may be on a percentage basis (e.g. individual Y spends 30% of his time monitoring the program) or on an absolute basis (e.g. individual Y spends six weeks each year monitoring the program).

C. Cost: To estimate the administrative costs of each task, multiply the amount of time spent by each staffer on that task by his salary, and then add up all costs for each task. For example, if individual Y spends 30% of his time monitoring a particular program, and his annual salary is $10,000, while individual Z spends 40% of his time monitoring the same program, and his salary is $12,000, the administrative cost of monitoring the program would be (.30 x 10,000) plus (.40 x 12,000), or $7800. A similar calculation should be made for those estimates made on an absolute basis. For example, if individual Y spends six weeks each year monitoring a program and his salary is $200 per week, the cost of that task would be $1200.

Please indicate the degree of confidence you have in your cost and time data by putting an "X" in the appropriate "Degree of Confidence in the Data Provided" Column.

D. Comments: Any additional comments you might have about the general subject of mandated federal programs would be appreciated.

DATA COLLECTION SHEET: Personnel and Administrative Costs of Complying with Federally Mandated Programs

Program: ______________________________

Program Description:

					Nature of the Cost		Degree of Confidence in the Data Provided			
Dates	Task	Staff Involved	Staff Time Required	Cost	One-time	Annual	Actual Cost	Estimate	Speculation	Comments

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Appendix III

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